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1887-8.

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TRANSACTIONS

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OF THE

Sanitary Institute of Great Britain.

VOLUME IX.

CONGRESS AT BOLTON.

1887-8.

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1888.

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NOTE.

The publication of this Volume has been delayed so as to include the work of the Institute up to the time of its amalgamation with the Parkes Museum.

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Sanitary Institute of Great Britain.

Formation of the Institute.

The increasing importance attached to Sanitary Science and the recognised position it was assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health. In furtherance of the object, a meeting was held at St. James's Hall, on the 13th of July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved:—

First—"That in the opinion of this meeting the sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health' a Society be now formed, to be styled 'The Sanitary Institute of Great Britain.'"

Second—"That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution and of reporting to an adjourned public meeting to be held during the second week in October next."*

The Committee appointed to report upon the subject considered it would add greatly to the usefulness of the Institute if Mayors of Boroughs, Chairmen of Local Boards, Sanitary Authorities, Medical Officers of Health, and all who have to administer the Public Health Acts, would associate themselves with the Institute, either in their individual or corporate capacity, and take part in its proceedings. By thus bringing their united knowledge and experience to bear upon Sanitary matters, the laws relating to the same would become better known and be more efficiently administered.

Basis of the Constitution of the Institute.

Section I.

Charter of Incorporation, Membership, and Government of the Institute.

As soon as practicable a Charter of Incorporation shall be obtained, as it will facilitate some portions of the work of the Institute, more especially the examinations as set forth in Section II. Until a Charter

* An adjourned public meeting was held on the 14th of March, 1877, when the report was unanimously adopted and a Council subsequently appointed to carry it into effect.

is obtained, the examinations shall be continued as heretofore, and a Register of persons certificated as competent to act as Local Surveyors and Inspectors of Nuisances shall be formed.

The Institute shall consist of Fellows, Members, Associates, and Subscribers.

Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators, and others, who have done noteworthy Sanitary work.

Fellows are only elected from among the Members, and they must have been Members for at least one year before they are eligible for election as Fellows.

All Fellows shall pay a fee of Ten Guineas on taking up the Fellowship, and such fee shall entitle the Fellow to all the privileges and advantages of the Institute for life without further payment.

Any person proposed by three Fellows or Members, shall be eligible for election as a Member of the Institute.

Members shall be elected by ballot by the Council, and shall be eligible to serve on the Council, and to vote at all Elections and Meetings of the Institute. The admission Fee payable by a Member shall be Three Guineas, and the Annual Subscription Two Guineas.

Medical Officers of Health and Medical Men holding Certificates in Sanitary Science from any University or Medical Corporation shall be entitled to be enrolled as Members of the Institute without Admission Fee.

Members desirous of becoming Life Members may do so on payment of Ten Guineas in lieu of the Annual Subscription.

All persons who have passed the Examination and received the Certificate for Local Surveyor from the Institute, shall, by virtue of having so passed, become Members of the Institute upon the payment of Five Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Any one proposed by two persons, either Fellows, Members, or Associates of the Institute, shall be eligible to be elected as an Associate of the Institute, the election to be by ballot by the Council. The Admission Fee payable by Associates shall be Two Guineas, and the Annual Subscription One Guinea.

All persons who have passed the Examination and received the Certificate for Inspector of Nuisances from the Institute, shall, by virtue of having so passed, become Associates of the Institute upon the payment of Three Guineas (without Annual Subscription), in addition to the fee paid for the Examination.

Persons of either sex, interested in the advancement of Sanitary Science, shall be entitled to be enrolled as subscribers on payment of One Guinea annually.

Donors of Ten Guineas and upwards shall be entitled to be enrolled as "Life Subscribers," with all the privileges and advantages of Annual Subscribers without further payment.

Fellows, Members, Associates, and Subscribers shall be entitled to attend and to take part in the discussions at all meetings and Congresses of the Institute, and shall have free admission to any

Conversazione given by the Institute and Exhibitions of Sanitary Appliances held in connection with the Institute as long as they continue to pay their Subscription.

Holders of Half-Guinea Congress Tickets are entitled to the use of the Reception Room in the town of meeting, to admission to the Presidential and other Addresses, to all the Meetings, to the Exhibition of the Institute, and to any Conversazione given by the Institute.

The Institute shall be governed by a President, Vice-Presidents, and a Council of Twenty-four, consisting of Fellows and Members of the Institute, of whom not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year.

The first President of the Institute shall be His Grace the Duke of Northumberland. Future Presidents and Vice-Presidents shall be elected by the Council. The Council shall have the power of electing Honorary Members of the Institute, Honorary Foreign Associates, and Corresponding Members of the Council.

Section II.

Objects of the Institute.

To devote itself to the advancement of Sanitary Science and the diffusion of knowledge relating thereto.

To examine and to grant Certificates of Competence to Local Surveyors and Inspectors of Nuisances, and to persons desirous of becoming such or of obtaining the Certificate. The Examinations shall be held at such times and in such places as the Council may direct.

A Board of Examiners shall be appointed by the Council; such Board shall consist of gentlemen representing Medical, Chemical, and Sanitary Science, Engineering, Architecture, and Sanitary Jurisprudence.

The Examination for Local Surveyors shall include a competent knowledge of the Statute relating to Sanitary Authorities, of Sanitary Science and Construction, and of Engineering.

The Examination for Inspectors of Nuisances shall comprise the elements of Sanitary Science, together with Sanitary Construction, and the Statutes relating to the prevention of disease and the suppression of nuisances injurious to health.

Fees shall be charged for the Examinations, and a Certificate of Competence, signed by the Examiners, shall be granted to successful candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

A Congress shall be held by the Institute for the consideration of subjects relating to Hygiene at such times and places as the Council may direct.

Exhibitions of Sanitary Apparatus and Appliances shall be held from time to time as the Council may direct.

Fellows, Members, Associates, and Subscribers shall have the right of Free Admission to the Exhibitions of the Institute whenever they are open. All fees payable by Exhibitors and the Public shall be fixed by the Council and belong to the Institute.

A Catalogue shall be published under the direction of the Council as a permanent record of the Exhibitions.

The Institute shall take such steps as may be within its power to obtain a complete registration of sickness, especially of preventible diseases.

The Institute shall endeavour to secure the services of medical men and others specially qualified to give lectures on subjects relating to the prevention and spread of disease.

The Institute shall encourage the formation of classes for technical instruction in Sanitary Science in such a way as may seem advisable to the Council.

A Library shall be formed in connection with the Institute.

ANNUAL REPORT OF THE COUNCIL

FOR 1886–7.

Ten years have now passed since the Institute was established, a period marked by a rapid increase in Sanitary knowledge, and a general recognition and application of the laws of hygiene. The Institute, endeavouring to keep pace with this advancement, has each year shewn steady progress in the work that it has sought to achieve, work which now receives a large amount of practical recognition from the public.

The Cash Statement shows a steady improvement in the financial position of the Institute; the receipts being larger than in any previous year, and although the expenses also shew an increase, the Council have reason to be satisfied with the general financial position of the Institute.

The Anniversary Meeting was, by kind permission of the Board of Managers, held in the theatre of the Royal Institution on July 8th, 1886. The Chair was taken by Sir Robert Rawlinson, C.B., Vice-President of the Institute, by whom the Medals and Certificates awarded at the Exhibition at Leicester in 1885, were presented to the successful Exhibitors. Dr. T. Whiteside Hime, Medical Officer of Health, Bradford, read a paper on "Pasteur and Preventive Inoculation against Zymotic Diseases."

The Annual Congress was held in the city of York, under the Presidency of Sir Spencer Wells, Bart., and the meeting was most successful. The arrangements made by the Local Committee were complete and satisfactory: the attendance was considerably larger than usual; 150 Members were present, and 250 Tickets were taken by Associates of the Congress, giving a total attendance of 400. The papers read were above the average; a full report of the proceedings, with the papers and discussions, will be found in the forthcoming volume of the Transactions, Vol. VIII.

At the suggestion of the Local Committee a new feature was added to the work of the Congress, viz. : a Conference of Medical Officers of Health, held in connection with the Sanitary Science and Preventive Medicine Section. To this Conference Medical Officers from all parts of the kingdom were invited, and subjects which come specially within their province were brought forward and discussed.

The Fine Art and Industrial Buildings, in which the Exhibition was held, were among the most suitable that have ever been placed at the disposal of the Institute. Besides the Hall used for the Exhibits, Picture Galleries in the building were thrown open to the visitors.

A Model Dairy was fitted up, and demonstrations of butter making, &c., and Cookery Lectures were given each day in the Exhibition.

The Electric Light was used throughout the building, considerably enchancing the attractiveness of the Exhibition, which was visited by 30,000 persons during the twenty-three days that it was open. There were one hundred and thirty Exhibitors. The Judges awarded eleven Bronze Medals of the Institute, eleven Special Certificates, and fifty-six Certificates—the Special Certificates being awarded to articles which had received Medals at previous Exhibitions of the Institute. Forty-two Exhibits were deferred for further practical trial and testing, and it is expected that the result of these trials will be reported at the Anniversary Meeting in July, when the Medals and Certificates will be presented.

The Examinations, which the Council feel to be one of the most important branches of the work of the Institute, are rapidly progressing in public favour. Each year an increasing number of candidates present themselves for examination, and the value of the Certificate is more widely recognised. Many Sanitary Authorities in the provinces, and several in London, mention the Certificate of the Institute in advertising for new Inspectors.

At the Examination in June sixty Candidates presented themselves : ten for the Local Surveyor Certificate, and fifty for the Inspector of Nuisances Certificate. Five Candidates were certified to be competent, as regards their sanitary knowledge, to discharge the duties of Local Surveyor, and forty-four to discharge those of Inspector of Nuisances. At the Examination in November, sixty-four Candidates presented themselves : nine for the Local Surveyor

Certificate, and fifty-five for the Inspector of Nuisances Certificate Five Candidates were certified to be competent, as regards their sanitary knowledge, to discharge the duties of Local Surveyor, and forty-two to discharge those of Inspector of Nuisances. Unsuccessful Candidates are privileged to offer themselves a second time without further payment.

The Courses of Lectures for Sanitary Inspectors and others, arranged by the Parkes Museum, have proved very successful, and have been of great assistance to Candidates coming up for the Examinations of the Institute.

The publication of a selection of the works of Mr. John Simon, C.B., which the Council mentioned in their last Report, will, it is expected, take place in the current year.

The proposal to publish these writings has been much appreciated, as evidenced by the Subscription list, already verging on 500 names.

The Council have to report with much regret the death of the Hon. Francis G. Molyneux and Dr. J. Gilchrist, Fellows; Henry Masters, M. Ogle Tarbotton, M.INST.C.E., E. Carleton Tufnell, and Thomas Waller, Members; and Lt.-General S. J. Batten, Subscriber.

Since the last Annual Meeting there have been elected 1 Fellow, 13 Members, and 18 Associates. The roll of the Institute comprised at the close of 1886: 92 Fellows, 192 Members, 64 Associates, 11 Subscribers, and 29 Honorary Foreign Associates: making a total of 388.

The retiring members of Council are: H. Percy Boulnois, M.INST.C.E.; W. Collingridge, M.A., M.D.; H. H. Collins, F.R.I.B.A.; Director-Gen. Sir Thomas Crawford, K.C.B., M.D.; R. B. Grantham, M.INST.C.E.; and M. Ogle Tarbotton, M.INST.C.E. (deceased).

The following gentlemen are nominated by the Council for election at the Annual Meeting to fill the vacancies thus created; Ernest Carritt, A.R.I.B.A.; C. E. Cassal, F.C.S., F.I.C.; W. Horton Ellis, F.R.MET.SOC.; Inspector-Gen. R. Lawson; Louis Parkes, M.D.; Edward Pritchard, M.INST.C.E.

Lectures upon Sanitary subjects have been given in the Parkes Museum during the year, and the Members of the Institute have had the privilege of attending these as well as of using the Library of the Museum, which contains a large number of works on Sanitary and allied subjects.

The Council referred in their last Report to the question of amalgamating with the Parkes Museum, which has been for some time under consideration. The proposed amalgamation has been fully approved by both Societies, and a joint petition has been presented to Her Majesty praying for the grant of a Royal Charter of Incorporation under the title of the SANITARY INSTITUTE. This petition was very influentially supported, and is now under the consideration of the Privy Council.

The Council have accepted an invitation to hold the ensuing Annual Congress and Exhibition in Bolton, a very thriving and energetic town. They trust that the visit of the Institute there will prove very successful, and result in much benefit to the inhabitants and locality of Bolton.

By order,

E. WHITE WALLIS,
Secretary.

74A, MARGARET STREET,
26*th May*, 1887.

SANITARY INSTITUTE OF GREAT BRITAIN.

Abstract of Cash Receipts and Payments for the Year ending December 31st, 1886.

	£ s. d.	£ s. d.
To Balance at Bank, January 1st		571 15 9
,, Admission Fees	48 6 0	
,, Life Compositions...	110 5 0	
		158 11 0
,, Annual Subscriptions		228 18 0
,, Transactions and other Publications ...	21 8 3	
,, Congress Sale of Tickets...	124 13 6	
,, Examination Fees...	264 12 0	
		410 13 9
,, Dr. Farr's Works		411 18 6
,, Mr. Simon's Works		1 4 0
,, Furniture		2 7 7
,, Transfer from Exhibition Account ...		300 0 0
		£2085 8 7

	£ s. d.	£ s. d.
By Rent and Taxes	65 12 6	
,, Salaries and Wages	285 2 10	
,, Postage, Telegrams, and Carriage ...	39 10 7	
,, Incidental Expenses	44 15 7	
,, Stationery and Printing	116 10 2	
,, Medals and Certificates	23 15 0	
,, Advertising	0 12 0	
		575 18 8
,, Transactions	278 13 1	
,, Congress	305 2 9	
,, Examinations	219 3 1	
		802 18 11
,, Dr. Farr's Works		440 16 10
,, Mr. Simon's Works		54 6 2
,, Amalgamation Expenses...		9 11 10
,, Balance at Bank, December 31st ...		201 16 2
		£2085 8 7

EXHIBITION ACCOUNT.

	£ s. d.
To Balance, January 1st	12 17 11
,, Receipts	1210 6 0
	£1223 3 11

	£ s. d.
By Expenditure	828 2 4
,, Transfer to General Account	300 0 0
,, Balance, December 31st	95 1 7
	£1223 3 11

Audited and confirmed,

MAGNUS OHREN,
EDWARD C. ROBINS, } *Auditors.*

May 21st, 1887.

ADDRESS

By Captain Douglas Galton, R.E., C.B., D.C.L., LL.D., F.R.S.

CHAIRMAN OF COUNCIL.

Read at the Annual Meeting, May 26th, 1887.

In accordance with the usual custom, it now falls to me to give you a short address. I would in the first place congratulate you on the present position of the Institute.

We had undoubtedly a most successful meeting at York. I say successful, because the papers or contributions were all of a high level, and the interest excited by the meeting extended far beyond the limits of the city and county in which it was held; and I feel sure that although Bolton is not so attractive a city, yet that, under the Presidency of Mr. Sclater-Booth, we shall have a not less important meeting this year. It is not however only in the case of our meetings that our efforts have met with success. Our examinations in Sanitary Science have attained a considerable development. Our certificates are beginning to be recognised as giving their holders a certain claim to candidature in appointments under sanitary authorities. The result has been that the number of candidates has steadily increased.

At the examination in June, 1886, sixty candidates presented themselves: ten for certificates as Local Surveyors, and fifty for certificates as Inspectors of Nuisances. At the examination in November, sixty-four candidates presented themselves: nine for Local Surveyors, and fifty-five for Inspectors of Nuisances. At the examination to be held next week, there are eighty-one candidates, of whom ten are for the Surveyor's Certificate, and seventy-one for Sanitary Inspector's. The fact of this progress in the number of our candidates is an index of the appreciation in which our examinations are held, as well as an evidence that these examinations supply a definite want; and so long as we conduct them with care, and preserve the safeguards by which they are now surrounded, we shall maintain their high character.

It will be in your recollection that we made last year an effort to supplement the examinations by inducing the Parkes Museum to organise preliminary lectures on the subjects included in our syllabus. Those lectures were well attended, and a further course was organised in advance of the examinations now about to be held.

I look upon it as a most important adjunct to the educational movement in sanitary knowledge, of which both the Sanitary Institute and the Parkes Museum are the expression, that these opportunities for instruction as a preliminary to our examinations should be afforded ; and the proposed, I trust approaching, union of the Parkes Museum with the Sanitary Institute will place in a very prominent light the almost wholly educational character of our Institute.

When we look at the results which we have achieved with our Examinations, our Congresses, and our Exhibitions, with their organised system of awards, we may well feel satisfied that the efforts which we have been making during the ten years of our existence, have tended to promote sanitary education and to raise the standard of sanitary knowledge throughout the country. Whilst however we have been endeavouring to stimulate sanitary knowledge in this country, we have not been unmindful of the desirability of keeping alive the recollection of the work done by the earlier pioneers of that science.

The basis of modern sanitary science rests on the development of vital statistics, and we owe the present state of vital statistics in this country to Dr. Farr.

Professor Gairdner said of him, in his address at Glasgow, that he had "done for the vital statistics of England almost what Harvey did for physiology, or Lavoisier for chemistry. He found the facts of this science in a state of almost hopeless and aimless confusion. He has not only added immensely to the number and value of these facts but has brought into them light, harmony, order, and for the first time in the history of the science has introduced a determinate method and an approach to scientific exactness. It has been the great and enduring merit of Dr. Farr (originally a modest country practitioner of the Company of the Apothecaries) to build up a body of doctrine on vital statistics, not only unequalled, but unapproached in any other country."

Dr. Farr may thus be said to have laid the foundation upon which true sanitary science must be built up ; because it is with the aid of, and the light thrown by, statistics, that the sanitarian is enabled to guide himself with accuracy through the maze of facts which every sanitary problem offers.

We induced Mr. Noel A. Humphreys to edit the vital

statistics of Dr. Farr, and the volume which he has produced possesses a very high value as a work of reference. I cannot but think that ere long we shall have cause to regret that we did not publish a larger edition.

The collection of vital statistics by the Government was coincident with the commencement of the Queen's reign. Before that time Dr. Southwood Smith as physician of the Fever Hospital at King's Cross had gathered facts from the patients who came to the Hospital, which proved that there were large classes of disease which he described as preventible diseases, the recurrence of which, by the adoption of sanitary means, would be brought under control.

But one of the early fruits of the system of vital statistics commenced under the supervision of Dr. Farr was the report of the Poor Law Commission on the condition of the working classes in 1842, which was drawn up by Mr. Edwin Chadwick, C.B. It is a remarkable tribute to the foresight of Mr. Chadwick that during the last half century almost all the sanitary principles laid down in that report have been recognised by the Legislature as necessary to the welfare of the community, and have become matters of ordinary practice. It is understood that Dr. Richardson is editing Mr. Chadwick's principal reports and papers.

Another of the principal workers in the sanitary field was Mr. John Simon, whose series of valuable reports forms a text book of sanitary science.

The Sanitary Institute has followed up the attempt to make generally accessible the knowledge of that branch of sanitary science represented by Dr. Farr's works, by arranging to have many of the more important reports of Mr. John Simon edited under his own general supervision; and this task has been committed to Dr. Seaton, who is at present engaged upon it.

Mr. Simon's reports commence with the period which followed the passing of what may be termed the first general Sanitary Act in 1848.

Amongst those who have been instrumental in spreading sanitary knowledge Mr. Simon stands out prëeminent. His position at the Privy Council Office afforded him vast opportunities; and in addition to the fact of the reports being full of matter which is of high value to the scientist, Mr. Simon's originality of thought, his power of reasoning, his clearness of expression, and his elegance of language,—all contributed to make them sought after by a large circle of readers.

If I now call your attention to some portions of Mr. Simon's reports, it is that you may measure in some degree the progress which the Nation has made in its methods of living since those

days when every one was allowed, in respect of his surroundings, to do much as he liked; and thus that you may be able to gauge the great influence which the combined efforts of Farr, Chadwick, Southwood Smith, Rawlinson, Simon, Sutherland, and some others have exercised on the Nation.

Mr. Simon's City of London reports were commenced in 1849. In his first report he says:—

"From such information as I possess, I may venture to speak of imperfect house-drainage as having been a general evil in all the poorer districts of the City. So far as I can calculate, some thousands of houses within the City still have cesspools connected with them. It requires little medical knowledge to understand that animals will scarcely thrive in an atmosphere of their own decomposing excrements; yet such, strictly and literally speaking, is the air which a very large proportion of the inhabitants of the City are condemned to breathe. In a very large number of cases the cesspool lies actually withing the four walls of the inhabited house; the latter reared over it, as a bell glass over the beak of a retort, receiving and sucking up incessantly the unspeakable abomination of its volatile contents. In some such instances, where the basement story of the house is tenanted, the cesspool lies—perhaps merely boarded over—close beneath the feet of a family of human beings, whom it surrounds uninterruptedly, whether they wake or sleep, with its fœtid pollution and poison. Now here is a removable cause of death."

"The cesspool nuisance has been the slow growth of other less enlightened ages, not in the City merely, but in the whole metropolis, and in all other towns in England. The extreme injury which it inflicts on the health of the population, and the vital necessity of abating that injury, are points which only began to claim attention in this country about ten years ago, and which have since but very slowly been forcing their way (chiefly through the indomitable zeal and perseverance of Mr. Chadwick,) into that share of notice which they deserve. House-drainage with effective water-supply are the remedies which can alone avail; and it is only during the present year that authority to enforce these measures has been vested by the Legislature in any public bodies whatsoever."

These paragraphs only exhibit one of the evil conditions which his reports show were so largely prevalent at that time, and which furnished the graphic name of filth diseases as applicable to that class of diseases to which the conditions gave rise. It was a condition of things from which we are now happily, comparatively speaking, free in England, but which undoubtedly still prevails largely in many parts of the continent, and certainly in large portions of India.

Mr. Simon's reports raise questions of still deeper import. He shows the degradation of the population in the crowded districts of the City, and he puts forward a doctrine which has not even yet received the full degree of acceptance which it should command in a christian country.

"If there be citizens so destitute, that they can afford to live only where they must straightway die—renting the twentieth straw-heap in some lightless fever-bin, or squatting amid rotten soakage, or breathing from the cesspool and the sewer; so destitute that they can buy no water—that milk and bread must be impoverished to meet their means of purchase—that the drugs sold them for sickness must be rubbish or poison; surely no civilized community dare avert itself from the care of this abject orphanage.

"If such and such conditions of food or dwelling are absolutely inconsistent with healthy life, what more final test of pauperism can there be, or what clearer right to public succour, than that the subject's pecuniary means fall short of providing him other conditions than those? It may be that competition has screwed down the rate of wages below what will purchase indispensable food and wholesome lodgment.

"All labour below that mark is masked pauperism. Whatever the employer saves is gained at the public expense. When, under such circumstances, the labourer or his wife or child spends an occasional month or two in the hospital, that some fever infection may work itself out, or that the impending loss of an eye or a limb may be averted by animal food; or when he gets various aid from his Board of Guardians, in all sorts of preventible illness, and eventually for the expenses of interment, it is the public that, too late for the man's health or independence, pays the arrears of wage which should have hindered this suffering and sorrow.

"Probably on no point of political economy is there more general concurrence of opinion than against any legislative interference with the price of labour. But I would venture to submit, for the consideration of abler judges than myself, that before wages can safely be left to find their own level in the struggles of an unrestricted competition, the law should be rendered absolute and available in safeguards for the ignorant poor—first, against those deteriorations of staple food which enable the retailer to disguise starvation to his customers by apparent cheapenings of bulk; secondly, against those conditions of lodgment which are inconsistent with decency and health."

Since these reports were written, the Legislature has made great advances in the direction of preventing the adulteration

of food; and the question of the housing of the working classes has received considerable attention. But we have not touched upon some of the more important questions here raised by Mr. Simon, viz., how, in our densely crowded towns, is our population to obtain the wages necessary for decent existence?

The principle upon which the progress which is being made in this respect may be said to be founded is that a community owes to its members the duty of removing from its midst preventible causes of disease, both in the interests of the richer as well as of the poorer members, because the prevalence of disease-causes affects all classes of the community in a greater or lesser degree.

This is the practical doctrine which underlies all Mr. Simon's reports. Their whole argument is a protest against the doctrine of "*laissez-faire*," which had emanated from the school of political economists in the earlier part of the century. And we are daily becoming more and more alive to the fact that this doctrine of "*laissez-faire*" is incompatible with the healthy existence of large communities. We are continually making progress in this direction, but very much remains to be done. In drainage, water supply, and the removal of refuse, the individual has been long compelled to conform to the regulations laid down by the community.

We have made in this direction considerable improvements on what was done when Mr. Simon's earliest reports were written; but no one will contend that our arrangements are as yet thoroughly satisfactory.

Take the case only of dust removal. Why, on my way here to-day, I passed a man loading ashes and decaying refuse from a dusthole into an open cart by means of a half worn-out open basket. Much of the refuse falls on the street, and much of the dust and refuse is carried by the wind into the faces of the passers-by.

We have not yet in dense aggregations of population taken any effectual means to prevent the smoke from our fires both polluting the air and materially diminishing the daylight, which is itself a necessary adjunct of health; and in this huge metropolis in which a population larger than that of some kingdoms is assembled on a comparatively small area, the evils of the use of fires which are not arranged to prevent smoke become daily more and more apparent.

Any one who will take the trouble to look will see that the smoke is no imaginary evil. The early morning may be hazy, but there is plenty of light; as soon, however, as the domestic fires are lighted, the haze often becomes a dark fog, or a dense canopy almost impenetrable to sunlight; and on many

days in the winter and spring the daylight is obstructed for hours.

The object of the sanitary Acts has been to provide for us in our houses and our streets a dry subsoil, fresh air and pure water. These are what may be termed the engineering aspects of sanitary knowledge. But Mr. Simon's reports are not confined to this side of sanitary knowledge. They deal with wider questions, and are so replete with careful reasoning on the occult causes of the propagation of disease, that it would be impossible here to do more than make a brief allusion to them.

His paper on the history of the Small-pox and system of vaccination is a complete repertory of information upon that subject, and a complete answer to those who have objected to vaccination. He shows that one of the most loathsome diseases, and one of the direst scourges that ever afflicted humanity, is controlled exactly in proportion as the operation of vaccination is well and thoroughly performed among the population. That those nations where it is compulsory on the whole population, and where the law is enforced with the greatest care and precision, that there the disease is almost obliterated. That in exact proportion to this care and precision in various communities, is the amount of immunity.

The progress of sanitary knowledge based upon the accurate record of facts, is leading us to see that members of the community must be restrained from freedom to propagate those diseases which are so highly infectious and contagious.

In this connection Mr. Michael, in a very interesting paper which he read some years ago to the Sanitary Institute, lays down the principles which he considers form the line of demarcation between what should, and what should not be made compulsory, where injury to the public is the result of neglect of sanitary laws.

He says: "1st, there should be certainty as to the cause of the injury; 2nd, certainty as to the efficiency of the proposed remedy; and 3rd, that the remedy is productive of no evil effects, and may advantageously be adopted."

Now this rule would entirely apply to the isolation of cases of infectious disease in special hospitals under carefully considered conditions, where the treatment of cases can be best carried on, and the subsequent convalescents placed under the most favourable conditions for perfect recovery. This is a necessity primarily in the interests of the healthy as against the sick, but with an equal amount of benefit to the sufferers themselves, and to their relatives and friends.

What is required to make these arrangements effectual to

prevent the spread of small-pox and other infectious diseases, but small-pox especially, is the immediate isolation of the patient when the disease first shows itself. Certain conditions are necessary to secure this. The first is, that every case of infectious disease should be promptly notified to the authorities; secondly, that the patient should be at once isolated; thirdly, that those who have been in immediate contact with the patient should be retained for a period under observation; fourthly, that the premises where the case occurred should be cleansed and disinfected, and any sanitary defects in them should be remedied.

In the enforcement of these conditions there should be no distinction between rich and poor, pauper and non-pauper cases, except the distinction between persons who can and persons who cannot be isolated at their homes, or in some place approved by the proper authorities. In default of such isolation, the authorities should be empowered and bound to remove to the hospital any patient capable of removal without risk to life or aggravation of the disease.

The notification of disease, the isolation of all patients whether rich or poor, the careful observation of all those who have been in contact with the patient, the disinfection of the house in which the patient resided at the time of his attack, and the removal of any sanitary defects which may be found in the house, are all links in one chain; and until these measures are made compulsory in the metropolis, and in the country generally, we are neglecting a powerful means of preventing the spread of small-pox and other infectious diseases.

One of the links of this chain which at present is not always considered, is the sanitary condition of the houses in which the cases occurred. The occurrence of a case of infectious disease in any house should be in itself taken as an index of the possibility of defects existing, and should be *prima facie* ground for a thorough examination of the premises and the surroundings by skilled persons. Because we should always feel that any arrangements which we may make for preventing the spread of infectious disease by isolation, are but aids or adjuncts to the effectual sanitation of the towns and houses; they are only wanted because our houses and towns are not in that good sanitary condition which it should always be our primary object to attain to. Indeed, many sanitarians have feared that by giving much prominence to checking the spread of disease by means of isolation, we divert attention from the real causes, namely, the insanitary state of dwellings and towns, which are the favouring conditions under which the propagation of these preventible diseases is encouraged; and we thus

weaken the efforts which the community ought to make to eradicate them.

It is possible that some years ago, when the sanitary education of the people was very far behind what it now is, it might have been so ; but now such results need not perhaps be so much feared; but it should be made the duty of that authority which is charged with receiving and dealing with cases of infectious disease in a town, also to investigate what are, in each instance, the conditions under which the patient was living at the time of his attack.

I trust that you will not think these brief remarks, which are the outcome of reflection upon a few of the very interesting questions raised in Mr. Simon's reports, are out of place here. I feel that any time is well spent which is devoted to calling attention to those bases of sanitation which have been laid down by the pioneers of Sanitary improvement ; and I should be glad if my present remarks should have the effect of drawing general attention to the valuable summary of Mr. Simon's reports, which under the very able editorship of Dr. Seaton, will soon be ready for issue.

ON THE SHORTCOMINGS OF SOME MODERN SANITARY METHODS.

Address by G. V. Poore, M.D., F.R.C.P.

Anniversary Meeting, July 14th, 1887.

I have been for some years so strongly impressed with the shortcomings of one of the chief methods of modern sanitation that I felt bound, when the Council of the Sanitary Institute did me the great honour of requesting me to deliver the annual address, to choose for my subject that which was uppermost in my mind.

The chief aim of sanitarians has ever been, and ever will be, the securing for the masses of the people the two chief necessities of life—pure air to breathe, pure water to drink. Whether or not we are able to secure these two necessities depends very largely upon the method which we adopt for the treatment of putrescible refuse, and it is on this point, and on the modern fashion of mixing putrescible refuse with water, that I propose to address you.

It may be well to remind you that all dead organic matter is putrescible, and, when I speak of putrescible matter, I mean all organic matter inclusive of excrement.

Nature moves in a circle, animals feed on each other and on vegetables, vegetables feed on the dead bodies of animals and vegetables, and on the solid and gaseous excrements of animals. Animal and vegetable life are complementary, and mutually support each other. This is a law of nature, and when I make this assertion I feel I run no risk whatever of being contradicted.

The laws of nature are inexorable; *i.e.*, they are not to be set aside by human prayers—not even by that best of all prayers, labour. Those who disobey the laws of nature or who enter into a contest with her are sure to be worsted in the end. If we fight with nature we court calamity.

I have elsewhere compared those who fight with nature to Sisyphus who according to the old mythology was condemned

in the lower world to a never-ending contest with the force of gravity—

> With many a weary sigh and many a groan,
> Up the high hill he heaves a huge round stone;
> The huge round stone resulting with a bound,
> Thunders impetuous down, and smokes along the ground.

By means of great expenditure of time and money, we may for a period wage with nature a war which may be apparently successful. The war can never be really successful, it will never terminate, nature in the end will assert her eternal sway, and crushing defeat must be our lot.

As the inevitable destiny of putrescible matter is to become the food of vegetables, a destiny which we can delay at the most only for a brief period, our proper course in dealing with it is clearly not to attempt to prevent or even to delay the inevitable. Such a course is to disobey the laws of nature, to fight with her and court ultimate defeat. Our wiser plan is to help nature in her work, and thus win her smiles.

It has been the wise custom in all ages of the world to dispose of putrescible matter by burial in the earth. Dead bodies have in all ages been buried, and the greatest of all lawgivers and sanitarians, Moses, whose likeness rightly takes the place of honour in this room, gave most explicit directions that excremental matters should be treated in the same way.

This is a not unimportant fact, and although we do not in this country follow the whole of the Mosaic law, nevertheless that law is so pregnant with marvellous wisdom that we ought not to discard any item of it without first questioning ourselves most strictly as to our reasonableness in so doing. The latest advances of modern science seem to show that in this particular Moses was absolutely in the right.

It has been shown, I think, conclusively that the decomposition of organic matter, whether in the earth, air or water, is brought about by minute fungoid organisms, the growth of which has the effect of resolving the highly complex organic compounds into soluble salts or gaseous bodies, which can be absorbed by the roots of plants.

Now when putrescible matter is buried in the earth it undergoes decomposition without the occurrence of putrefaction—that process which is at once offensive to the senses and dangerous to health. This is effected by means of mould fungi, which produce oxidation of the organic bodies. If sufficient air has access to the pores of the soil, and if sufficient moisture be present, the nitrogen takes oxygen to form nitric acid, which, combining with the bases, forms soluble nitrates, and the

carbon also combining with the oxygen forms carbonic acid which, combining with the bases, forms carbonates.

The best account which I have been able to find of the active organisms which are ever present in the soil, is in a paper by Professor Wollny,* of Munich, which was brought to my knowledge by my friend, Dr. E. F. Willoughby. These organisms are so incalculably numerous that their activity must be exceedingly widespread. Koch found enormous quantities, even in winter, in the soil not only of crowded places like Berlin, but in that also of remote fields. At the observatory of Mont Souris 750,000 were found in a gram of earth, and at Genevilliers from 850 to 900,000.

If the action of the microbes be checked by antiseptics, the vapour of chloroform or by heat (100°c), the chemical changes in the earth cease.

That the formation of nitrates and carbonic acid from organic matter in earth to which air has access is due to microbes has been proved by direct experiment. When however organic matter is mixed with earth, and air is admitted in insufficient quantity or entirely excluded, the decomposition is of another kind; and besides small quantities of carbonic acid and carburetted hydrogen, there is formed water, ammonia, free nitrogen, and a great quantity of a black carbonaceous peat-like matter (the so-called sour humus).

Schlösing found that the nitric acid in the soil disappeared when the air was replaced by nitrogen.

The kind of organism seems to vary with circumstances. As long as air is freely admitted, the mould-fungi (schimmelpilze) preponderate; and when air is excluded, the schizomycetes (spaltpilze) increase.

The formation of nitric acid in organic earth mixtures depends on the amount of oxygen which is present in the air admitted. Thus Schlösing found by experiment that the formation of nitric acid varies as under:—

Oxygen	1·5°/₀	6°/₀	11°/₀	16°/₀	21°/₀
Nitric Acid	45·7 m.g.	95·7	132·5	246·6	162·6

The nitrification which took place with a limited supply of oxygen was due probably to the air already mixed with the earth before the experiment began.

Miller and Boussingault have shown that no nitrification takes place in thoroughly soaked earth to which little air has access, and that when oxygen is absent the nitrates in the earth are

* "Ueber die Thätigkeit niederer Organismen im Boden." Deutche Vierteljahrsschrift für Offentliche Gesundheitspflege, Vol. 15, 1883, p. 705.

reduced. The formation of carbonic acid also depends upon the admission of air (containing free oxygen), but some carbonic acid is formed even though all air be excluded.

Oxygen in air	Pure N	6°/o	11°/o	18°/o	21°/o
Carbonic acid	9·3 m.g.	15·9	16	16·6	16

Nitrification is assisted by a moderate amount of moisture. It attains its maximum when the moisture reaches 33 per cent., and above and below this the process of nitrification and formation of carbonic acid is hindered.

Temperature has a great influence on oxidation in the earth. It reaches a maximum, with a temperature of about 50° C., (120° F.) and stops at 55°.

Oxidation goes on most quickly in the dark.

Thus, oxidation depends not only on the presence of the organisms, but also on the presence of other factors, such as suitable aeration, suitable moisture, suitable temperature.

These factors may all be suitable, or some may suit and others may not suit the oxidation process.

The decomposition of organic matter in the soil is governed by that factor which is at its minimum.

The process of decomposition is much influenced by the physical condition of the soil, as, *e.g.*—

(a.) Permeability for air and water.

(b.) Nature and permeability of subsoil.

(c.) Slope.

(d.) Aspect.

(e.) Warmth dependent on aspect, mineral composition, colour and moisture and nature of the crop. Barren soils are warm, while those covered with green crops are cool.

That the variations of the ground water have a bearing on the oxidation processes cannot be doubted, when we reflect that the soaking of the upper layers of the earth is much influenced by the height of the ground water. When all the layers of earth are soaked, putrefactive processes, through the medium of Schizomycetes, take place. When the ground water falls, and the air again enters the pores of the soil, the growth of those organisms is favoured, which assist in the oxidation of the soil.

All changes which organic matter undergoes in the earth are thus seen to be brought about, almost exclusively, by the life of lower organisms the activity of which is ruled by the same natural laws which govern the growth of higher plants.

There can be no better illustration of the true economy of nature than this action of the microbes in the soil on the conversion of organic matter into soluble salts and gases which serve as food for plants.

The growth of the microbes depends upon the concurrence of those conditions which, by experience, we all know to be favourable to the growth of higher plants. There must be a good supply of free oxygen, sufficient, but not too much, moisture and a summer temperature. In well-tilled ground, broken up so as to admit air to its pores, and in a "fine growing season," in which sunshine alternates with showers, this process of oxidation is at its maximum. The microbes are active beneath the surface manufacturing plant food from organic matter, and the favourable conditions above soil and below cause a vigorous growth of crops.

When, on the other hand, the weather is unfavourable, and when in consequence of excessive cold, excessive drought or excessive wet, crops are not developed as they should be, the microbial life is also checked, and the change of the organic matter is delayed, and it is stored up for future use in more favorable seasons. This is the explanation apparently of the fact well known to farmers, that the effect of organic manures is more permanent than that of the so-called artificial manures, which at present are so much in vogue. The organic manure remains entangled in the soil and is not readily washed out of it in winter when the temperature is low, or even in unpropitious summers. It cannot be washed out until microbial growth has changed it into soluble salts and when this change takes place, which it does in "good" weather, the roots of the growing plants seize hold of the ever-forming soluble salts and appropriate them to their own use. In fact the farmer who uses organic manures from the farm-yard or elsewhere, need trouble himself very little with agricultural chemistry or experiment.

He may feel certain that if he buries his organic manure *directly it is produced* it will not be wasted. It will not give off ammonia to the air, nor will the juices be washed away by rain to the same extent as when it is left above ground to be a nuisance. There seems to be no doubt whatever that all heaps of manurial matter which give off ammonia and other gases to poison the air, and perhaps do more serious mischief which we "know not of," are allowing valuable matter to escape, which ought to be undergoing oxidation in the earth. There can be no doubt whatever that to the agriculturist stink means waste, and it is to be hoped that when the bucolic mind has imbibed this great and important truth, the country will be more evenly pleasant than it is.

The reason why farmers allow putrescible matter to fester in heaps appears to be—

(1). That the matter has to wait until land is clear and circumstances permit of its being dragged to the fields; and (2)

that when the matter is thoroughly rotten and most offensive, a *more rapid and visible* result is produced, notwithstanding that the total result is probably less than if it had been applied to the ground at once. It is certain that putrescible matter intended for manure must waste more above ground than when buried immediately beneath it. Rich farmers are now building sheds over their yards to prevent the access of rain to the manure, and are providing tanks for the reception of liquid which drains away. This involves a very great expense, and it is at least doubtful whether the result is better than that got by the immediate application of such matters to the soil—a process which involves no extra expenditure of any kind—a most important matter, because the only acceptable test of good husbandry is the balance sheet.

Mr. Warington, F.R.S., in his valuable little book on "The Chemistry of the Farm," says, "The most complete return to the land would be accomplished by manuring it with the excrements of the men and animals consuming the crops" (p. 28); and again, "Farmyard manure is a 'general' manure; that is, it supplies all the essential elements of plant food. * * The effect of farmyard manure is spread over a considerable number of years, its nitrogen being chiefly present not as ammonia, but in the form of carbonaceous compounds, which decompose but slowly in the soil."

The immediate return is often less than when artificial manure, consisting of soluble nitrates and phosphates is used, but the important point seems to be that the return is tolerably sure to come in the long run.

The late Professor Voelcker, in the article, "manure," in the "Encyclopædia Britannica," gives an interesting table of the experiments of Sir John Lawes and Dr. Gilbert, spreading over a period of 24 years, in which is shown the effect of different manures on crops. The most successful results with artificial manure were got by applying nearly 1,400 lbs. weight per acre of mixed ammonia salts, superphosphate and sulphates (potash, soda, and magnesia). With this manure there was an average production of 37½ bushels of wheat, weighing on an average 59 lbs. per bushel, and multiplying these two figures together we may say that the production of wheat averaged 2,212·5 lbs. The production of barley averaged 41½ bushels, weighing 53⅜ lbs., and multiplying these figures we may say that the average production was 2,588 lbs. Where the land was manured with 14 tons of farmyard manure the average production of wheat was 35¼ bushels, weighing 60 lbs., giving a figure of 2,115 lbs., and of barley, 48¾ bushels, weighing 54⅜ lbs., giving a figure of 2,650 lbs.

This farmyard manure, when used for wheat growing, gave a yield of 97 lbs. less than when the best artificial manure was used; and when used for barley growing it gave 62 lbs. more than when artificial manure was used. These figures are certainly not such as should discourage us in the use of farmyard manure, especially when we remember that the average agriculturist is not likely to apply his artificial manures with the knowledge and judgment of Messrs. Lawes and Gilbert; and that in the use of farmyard manure it is not easy for him to go very wrong. Again, farmyard manure is stuff which *must* be used, while chemicals are things which *must* be bought, and need to be analysed when bought.

It is a great mistake to suppose that farming is in any way comparable to a chemical experiment. In experiments conducted in the laboratory the chemist is able to control *all* the conditions of the experiment, but in farming the condition which above all others influences the result, viz., the weather, cannot be controlled.

When chemical manures are used with judgment and applied at the right moment, and when the weather is favourable, there is no doubt that the result is often surprising and gratifying. When however the weather is unfavourable, when the drought is so great that the chemicals cannot be dissolved, or when the rain is so heavy that they are washed out of the soil, the result is not encouraging. If organic manures are used, they do not waste in bad seasons, and much remains in the ground for next year's crop. The farmer however who applies chemicals in a bad season, gets neither crop nor residuum of manure for next year. Mr. Warington says that "farmers have a prejudice in favour of the latter (*i.e.*, organic) manures, but it is clear that the quickest return for capital invested is afforded by the former class" (*i.e.*, inorganic).

Surely we have no right to blame the farmers for their prejudice, which seems to be in all respects reasonable. The doctrine has obtained in this country of late years that it is good economy to waste all our home-grown organic manure, and to import chemicals from South America for the purposes of agriculture. This is a strange doctrine; but as most of our farmers are now too near bankruptcy to pursue this course, we may hope that ere long they will begin to clamour for that which we now waste so wickedly.

One more word before I bring my remarks on farming to a close, remarks for which I make no apology, for I feel sure you must already recognise their bearing on the subject of sanitation.

The remark I have to make is this, that in the hands of Lawes and Gilbert farmyard manure gave better results with

barley than with wheat. May not the fact that farm animals are largely fed with barley-meal, have something to do with this. There are experiments which show that minimal ingredients in manures are not without effects which are often surprising. There are *a priori* grounds for thinking that the best manure for barley must be the excrement of a barley-eating animal, for in that excrement must be all that is necessary for barley. I wish some agriculturist would make the experiment of growing wheat with the excrement of a wheat-eating or bread-eating animal. As a gardener I have grown potatoes with the excrement of a potato-eating animal, and certainly the result has been most encouraging.

I have been obliged to draw my illustrations as to the practical result of burying organic matter from the agricultural employment of farmyard manure, because facts based upon exact experiments with the organic refuse of our towns is not forthcoming.

What I want to insist upon is this, that the proper destiny of organic refuse is immediate burial just below the surface of the soil.

Most of the shortcomings of modern sanitary methods are due to the fact that in our dealing with organic refuse we commit a scientific error, *i.e.*, we pursue a course which is in opposition to natural law.

This error consists in mixing organic refuse with water.

When organic refuse is mixed with water, it undergoes changes which differ widely from the changes which it undergoes when mixed with earth.

According to Wollny whose paper I have quoted previously, the process of oxidation of organic matter and the formation of nitrate takes place most readily when a moderate amount of moisture is present. The most favourable amount is about 33 per cent., and if the moisture rise above or sink below this amount, the process of nitrification and the formation of carbonic acid is hindered. When water is in excess the amount of free oxygen is insufficient to favour the growth of mould fungi, the schizomycetes (Bacteria and Micrococci) are formed, and in place of oxidation, putrefaction takes place with the formation of ammonia, free nitrogen, carbonic acid, and carburetted hydrogen. Under these unfavourable circumstances it is possible that the nitrates which may have been formed may be again reduced.

This process of de-oxidation takes place in mixtures of putrescible matter with water, and takes place also, it is said, in soil which is thoroughly soaked with sewage (*i.e.*, putrescible matter mixed with water). In the face of these facts it is not to be

wondered at that "sewage farming," which is farming under acknowledged difficulties, has not proved a commercial success. We must indeed be in doubt whether, when the circumstances are more than usually unfavourable, it exercises any very great purifying action upon the putrescible mixture. In the treatment of putrescible refuse, so that it shall not be a danger or annoyance, what we have to aim at is nitrification rather than putrefaction, and it is certain that by mixing with water putrefaction is encouraged and nitrification delayed.

It certainly seems to be almost incontestable that the proper course to pursue with regard to organic refuse—putrescible matter—is the very reverse of that which we do pursue. We clearly ought to encourage oxidation, and make putrefaction impossible.

Putrefaction is certainly a great cause of ill health. It was the putrefaction of wounds (now happily almost unknown) which converted our hospitals into something little better than charnel houses. It is the putrefaction of organic refuse mixed with water in cesspools and sewers that causes that long list of ailments which we ascribe to the inhalation of "sewer air."

The opinion is held by many that the dejecta of typhoid patients and cholera patients do not become dangerous to others until putrefaction has set in, and such an acute observer as was the late Dr. Murchison held the opinion that common putrefactive changes taking place in dejecta were a sufficient cause of typhoid, independently of the admixture of any specific poison.

The putrefaction of organic refuse, when mixed with water, has I think been the chief cause of the development of modern sanitary "progress." Our forefathers were not given to this method of treating putrescible matter. House-slops trickled along open gutters, and excremental matters were deposited in dry pits. At the beginning of this century the water-closet came into use.

Mr. W. Haywood, quoted by Dr. Farr, says, "Water-closets were invented about 1813, and became general in the better class of houses about 1828-33. The custom at first obtained of building cesspools having overflow drains put below their doming, by which means the solid matters were retained, and the supernatant liquid only ran off.

"In the year 1849, what may be said to be an organic change in the system took place. In 1848 the City Commission of Sewers obtained its Act for sanitary purposes, which became operative on January 1st, 1849, and then for the first time was discharge into the sewers legalised. Previously a penalty might have been enforced for such a usage of them, but henceforth within the City of London those incurred a penalty who

failed, upon notice, to construct the drainage of premises in such a manner as not to discharge all waste waters *and fœcal matters directly into the public sewers* [*i.e.*, directly into the sources of water supply] of which the full utility was therefore for the first time recognised by statute. This Act was speedily followed by others for the remaining area of the metropolis and for the entire country."

"It will be noticed," says Dr. Farr, "that the deaths from cholera and diarrhœa increased in London in 1842, increased still more in 1846, when the potatoe crop was blighted, and in 1849 culminated in the epidemic of cholera.

Dr. Farr says further, "a system of sewerage is the necessary complement of a water-supply."

"Almost coincidently with the first appearance of epidemic cholera, and with the striking increase of diarrhœa in England, was the introduction into general use of the water-closet system, which had the advantage of carrying night soil out of the houses, but the incidental and not necessary disadvantage of discharging it into the rivers from which the water-supply was drawn."

Mortality per 1000 from diarrhœa in London (Dr. Farr):—

1838	·215	1853	1·011
1839	·201	1854	1·257
1840	·238	1855	·804
1841	·238	1856	·866
1842	·353	1857	1·181
1843	·410	1858	·759
1844	·340	1859	1·211
1845	·397	1860	·496
1846	·997	1861	·928
1847	·898	1862	·607
1848	·853	1863	·821
1849	1·705	1864	·981
1850	·813	1865	1·206
1851	1·085	1866	1·306
1852	·983	1871-80—Dr. Ogle	·940

Thus in the decade 1871–80, 33,168 persons died of diarrhœa in London, the death-rate from this cause being ·94

If the death-rate of 1838 (·215) had obtained in the decade 1871–80, the deaths from this cause would have numbered only 7,600, and there would have been a saving of 25,568 lives.

Since the introduction of the water closet, and I believe as a direct consequence of it, we have had four severe epidemics of cholera, a disease not previously known, and enteric or typhoid

fever, previously almost or quite unrecognised, has risen to the place of first importance among fevers in this country.

The evils which have arisen from cesspools and sewers has caused an enormous amount of attention to be devoted to what are known as "sanitary appliances," sewer constructions, &c., and so great and so well recognised are the evils of sewers that many of our friends are anxious that we should be compelled, by Act of Parliament, to protect ourselves from the mischief which previous Acts of Parliament have produced.

Not only does the putrefaction of organic refuse tend to fill the air of our houses and towns with foulness, but this mixture of organic matter with water is attended with other bad consequences.

This arises from the fact that much of the organic matter which we mix with water is distinctly poisonous. The zymotic theory of disease has of late years assumed more definite shape, so that we may now leave what was called the zymotic *theory* and consider the actual facts.

There is no doubt that the actual infective elements of many zymotic maladies consist of microbes, fungoid bodies belonging to the class of fungi known as Schizomycetes, that class which grows in organic mixtures where insufficient free oxygen is present.

These microbes are infinitely small; millions of them may live in a cubic inch of putrifying liquid. Under favourable circumstances they will live for long periods. They will not only live but multiply, and it is at least a question, and a grave one, to what extent these infective germs undergo an increase when mixed with organic liquids such as sewage or milk?

The fact that the zymotic poisons are *particulate and alive* is one which has most important bearings on the subject under discussion. If the poison were a chemical poison, then dilution would practically do away with its power for harm. No amount of dilution is capable of destroying a zymotic poison, in fact it is not impossible that the mere mixing of organic refuse which contains a zymotic poison with water may be the means of keeping it alive and possibly causing it to multiply.

When a mass of organic matter, charged with zymotic particles, is mixed with water and washed out of a house, the water will carry the poison with it wherever it may chance to flow or trickle, to water course, well, or any other source of drinking water; in fact the dissemination is as perfectly and thoroughly done as if dissemination of poison were the main object which we had in view.

When dealing with organic matter impregnated with zymotic

poisons, mere dilution with water increases rather than diminishes the danger.

As long as the poisonous organic refuse is concentrated, its repellent qualities are such that there is little chance of its gaining access to the human body. The microbes contained in it are theoretically capable of infecting an almost indefinite quantity of water, and this large quantity of water masks the repellent qualities of the stuff, and thus the danger of infection is greatly increased.

This dissemination of poison by water is one of which we have had very bitter experience in this country.

There is little room for doubt that, in this country at least, water has been the great carrier and disseminator of the poison of cholera.

In 1849 the mortality in London was highest in those districts getting their water supply from the Thames between Battersea and Waterloo Bridge.

In 1853-54 the same phenomenon was observed. In 1866 the chief mortality was in the district supplied with water taken from the river Lea. With regard to this latter epidemic, we are in possession of many details, and the following is a summary of the facts as given by the late Dr. William Farr in his report on the cholera epidemic of 1866:—

"Several cases of cholera and choleraic diarrhœa had occurred over London in May; and on 27th June, at 12, Priory Street, Bromley, one poor Hedges, a labourer, and his wife, both of the age of 46 years, died of 'Cholera Asiatica,' the former after 15, the latter after 12 hours' illness. These cases are minutely described by Mr. Radcliffe, who traces the discharges into a water closet of 12, Priory Street, and thence 300 yards down the sewer into the Lea (a tidal river which ebbs and flows) at Bow Bridge, half a mile below the Old Ford reservoirs. He attaches great importance to these first cases, and they undoubtedly sufficed to pour into the sewers and waters millions of zymotic molecules, which day by day grew more and more frequent in the Lea, by every hour's choleraic discharges on both sides of the river." A few days later water was supplied to the district from a reservoir, the bottom of which was pervious to the waters of the Lea, and then resulted an outbreak of cholera and diarrhœa which caused the death of over 4000 persons.

I need not give further instances of the dissemination of disease by water-carried sewage, sanitary literature is full of them.

What is true of cholera is also true of typhoid, and I will only say in reference to this subject that (if we accept, as we are

bound to do, the statements put forward with regard to the cholera epidemic of 1866), if the excreta of the Hedge's family had been buried or burnt, the waters of the Lea would not have been infected, and possibly 4,000 lives would have been saved.

The first principle in dealing with epidemic disease is that which is expressed in the words, *principiis obsta*, resist the beginnings. The object of this is evident, and is well expressed by Shakspere in the words—

> " A little fire is quickly trodden out,
> Which, being suffered, rivers cannot quench."

The mixing with water may be looked upon certainly not as a resistance of the beginnings, but rather as a nursing and favoring of them, which, " being suffered," most surely " rivers cannot quench."

The great principle of *principiis obsta* has been most rigidly observed by surgeons in dealing with those forms of blood-poisoning which arise in connection with wounds, and which were known as hospital diseases. To Lister belongs the credit of recognising that the great thing to be aimed at was the checking of putrefactive changes in the discharges from the wound, an end which has been attained by adopting what are known as antiseptic precautions in the treatment and dressing of wounds. A foul wound is looked upon as a great source of danger to the patient himself, and formerly the poisons generated in the wound of one patient were carried by sponges and instruments (which, be it remembered, were " *clean*," as far as any indications appreciable by our unaided senses were concerned) to the wounds of others ; and thus it followed that the mortality from what was wrongly spoken of as " hospitalism " was enormous. Now, however, putrefaction in wounds is practically at an end, owing to the use of antiseptics and to an improved appreciation of what cleanliness really means ; and as a result of this hospitalism has disappeared.

How marvellous have been the results which have followed on the adoption of the principle of preventing putrefaction in wounds is well shown in a table given in the last edition of " Erichsen's Surgery." This table is taken from a statistical work by Max Schede on amputations, and shows conclusively what are the advantages of antiseptic precautions. I have simplified his statement for the sake of those of my audience who are not acquainted with medicine.

UNCOMPLICATED CASES OF AMPUTATION.

Cause of Death.	Old treatment, 377 cases.	Antiseptic treatment. 321 cases.
Blood poisoning	105	3

Thus it appears that the mortality from blood poisoning under the old treatment was 28 per cent., while under antiseptic precautions it is less than 1 per cent.

Antiseptic measures are used in other than purely surgical cases and my friend Dr. John Williams tells me that since their introduction into the General Lying-in Hospital the deaths from that terrible disease "puerperal fever," have practically ceased.

This great result has been brought about by attention to the leading principle of *principiis obsta.*

In my student days the treatment most in vogue for wounds was "pure" water; but now it is recognised that water is pre-eminently the encourager and sometimes the main cause of putrefaction, which of all things the surgeon tries to avoid.

The foulness of our rivers is largely due to the mixing of putrescible matter with water, *i.e.*, to water-carried sewage, and there can be no doubt that as water-carried sewage increases, the difficulty of obtaining pure water increases also. Water-carried sewage so fouled the Thames "between the bridges," that after the bitter experiences of 1854, the in-take of the water companies was moved to a point above the tide-way. Since then the population all along the Thames Valley has enormously increased, and if we who get our drinking water from the Thames escape disease, it can only be regarded as due to a happy accident, and not to the observance of any fixed principle to effectually prevent the fouling of the river. The precious liquid with which I am supplied from the Thames costs me I think nearly ten shillings per thousand gallons, and I need not say that I am very careful to have every drop which is used for drinking purposes both boiled and filtered.

If sewage finds its way to a water-source I have not much faith in the various modes of "treatment" which it undergoes in those establishments which local boards love to erect for this expensive amusement.

The addition of chemicals, if in sufficient quantity to destroy living organisms, must make the water still more unpotable than before, and can only be of use by making the liquid so utterly nauseous that to drink it would be impossible.

Mere filtration cannot be regarded as any safeguard after the experience of the Lausen typhoid epidemic, in which the poison

of the fever filtered through a mile of earth, which was sufficient to check the passage of particles of wheat flour. Wide irrigation over a large area of land, as is practised in "sewage farming," is probably the best method of treating sewage, but this cannot be regarded as absolutely safe under all conditions for reasons previously indicated.

If antiseptics have been previously added to the sewage, this must increase the difficulties of "farming" with it, as, if the antiseptics have been added in sufficient quantity to destroy disease organisms, this would effectually check the growth of those other organisms upon which the fertility of the soil depends.

It is more than doubtful whether there is any absolute safety in obtaining water from deep wells. The Dudlow Lane well, near Liverpool, having a total depth of 443 feet, was fouled by percolation from cesspools, and percolation from a defective sewer would certainly prove equally disastrous. Surface wells are not now regarded as at all safe, but our suspicions with regard to them were not aroused until after the introduction of the plan of mixing water with putrescible matter. There was no soakage from an old-fashioned dry pit. There must be soakage from a cesspool or "dead well."

The only way of securing pure water is to make quite sure that there is no fouling of water-sources. If this were done, then pure water would be at once plentiful and cheap. It is now very dear, and is getting scarcer every day.

Dr. William Farr said, "a system of sewerage is the necessary complement of a water supply." For myself I should be inclined to say that an extraordinary water supply is the necessary complement of water-carried sewage, because with it our ordinary supplies quickly get fouled. In London we have effectually fouled all our wells, and the state of the Thames is such that a man must be in the very extremities of thirst or else insane before he would drink from the Thames anywhere between Teddington Lock and Gravesend. The state of our noble river is a deep reproach to us, and must remind us day by day of the serious blunders we have committed. As long as it remains as it is, we certainly have no claim to be followed as an example in matters sanitary. London should serve as a warning, as did the drunken Helot to the Spartan Youth.

The fouling of our sources of water supply has driven us far afield for water, and this no doubt has been a great cause of the lessening of our mortality of late years, but it would be unwise to talk of security because we have had no serious epidemic since 1866, an absurdly short period in the history of a nation. It must not be forgotten that pure water is as necessary for animals as it is for man, and that if we persist in

fouling our rivers the poor farmer may have to pay a "water-rate" for providing an artificial water supply for his horses, cattle, sheep, and even poultry. Many diseases of animals are communicable to man, and it is daily becoming more evident that our health is very intimately bound up with the health of our animals, and that their sanitary condition is scarcely less important than our own.

From a financial point of view, water-carried sewage has not been encouraging. It has increased the rates, increased the cost of our houses, and put us to great expense for water. The "treatment" of sewage before it is finally discharged into our rivers is everywhere an expense and nowhere a source of profit, and we find that public sewers which cost millions to construct, cost thousands to keep in repair.

The sewers we have built with borrowed capital. We have seized all the glory and patronage of disbursing enormous sums, and have left posterity to pay the bills. This is a doubtful policy, and I think a most immoral one, but I feel it is little use to raise my feeble voice against the custom which is now so much encouraged of hanging a debt round the neck of our successors. It may be defensible to raise a loan for building town halls, schools, and similar edifices, of which posterity will reap the benefit, but to raise loans for the purpose of wasting most valuable fertilising matter by means of works which will be a constant expense, and never a source of profit, is a very doubtful expedient.

I hope the custom will soon obtain of compelling each generation to bear the charge of its own sanitary experiments—and blunders.

Sewers are constant sources of impoverishment to the soil, and the soil be it remembered is the only *permanent* and reliable source of wealth in any country. The waste of valuable matter which takes place in London and our big towns must make us blush. I wish the waste were limited to our big towns, but it is not so. It is common throughout the country, even in rural districts. Free trade has made food very cheap indeed, and cheap food, especially *imported* food, ought absolutely to increase the fertility of a country, for obvious reasons which I need not particularize. The fertility of this country is not increasing to judge by the agricultural distress. The farmers are crying out for "protection." The first kind of protection needed seems to me to be a protection from ourselves and from the sinful waste of fertilising matters which Local Boards, Municipalities, and Imperial Parliament equally foster.

If we made a proper use of our organic refuse we should enrich posterity. As it is we reap and we do not sow. If municipalities would bury organic refuse, and plant the seed of

some forest tree suited to the soil and situation (which in these days of cheap food stuffs would probably be the best branch of agriculture to pursue), they would earn the blessings, instead of the curses of posterity; and they would beautify the face of nature, instead of making it hideous with tall chimneys, pumping stations, and precipitating tanks. This piece of advice will I fear fall very flat, for of all agricultural arts, forestry seems the deadest in this country.

As a defence for gigantic sewage schemes, it is often said that you can do nothing well without co-operation, and this is the excuse for compelling all, whether they want them or not, to contribute towards the cost of sewers.

If co-operation be for a good end, the result is a great good; but if co-operation be for a bad purpose, the result is a great evil. I need say no more.

The last charge which I have to bring against water-carried sewage is a serious one, viz., that it encourages overcrowding in cities, which is universally admitted to be the greatest of all sanitary evils, and one which cannot be counterbalanced.

Water-carried sewage encourages overcrowding becauses it enables us to build houses with no outlet except a hole for the sewage to run through. The growth of London must be a source of alarm to sanitarians, and it is impossible not to admit that our system of sewers has been a most important factor in its production. Look at Charing Cross, where a street of gigantic clubs and hotels has arisen, each without curtilage of any kind, and where a handsome profit has been made by setting the first law of sanitation at defiance. You will find the same thing to a greater or less extent throughout the Metropolitan area.

It is difficult to say why we are so prone to crowd into cities. In former days we crowded behind walls as a protection from our enemies. Those days are at an end, but the crowding is greater than ever. The common cant of the day is that in this 19th century we have annihilated time and space. Certainly in cities both are excessively precious. The telegraph, the telephone, and the steam engine, ought to have diminished overcrowding, but they have not. The stream is still, mainly from the country towards the town, the attraction being the making of money and the spending of it.

It may be well to glance at the effect of this overcrowding in this city.

It is a common remark that London is a very healthy city, and as a proof of this assertion persons point to the death-rate, which certainly of late has not been excessive. The London of the Registrar-General however is a very extensive place, and many of the outlying parts are almost rural in character, so

that if you want to find the effect of living in a crowded city, it is not fair to take London as a whole.

I am no believer in the healthiness of London. It is true that our death-rate has not been raised by any great epidemic of late years, but London is undoubtedly a city where an abundance of second-rate health exists. The crowds that throng the doors of hospitals increase, and in my profession there is a great outcry about "hospital abuse," which means, I take it, that decent folk are not able to cope with the amount of chronic disorders with which they are beset. Again, the mobility of the population in the present day makes our vital statistics very uncertain. Many a healthy person is imported into London, and being wounded in the battle of life, returns to the country to die or recover as the case may be. There is a scarcity of very young and very old people, and in order to appreciate the vital statistics of London, great allowances have to be made for the abnormal age distributions.

In order to judge of the effect of over-crowding, let us look at the vital statistics of the "Strand" Registration District, which is about the centre of London, and from which one would have to walk very many miles to reach the country in any direction.

The "Strand" enjoys many advantages. It is mainly a wealthy district, extending in irregular form from Temple Bar to Buckingham Palace. It includes the whole of the Green Park and half St. James's Park. It has a gravel soil, and slopes gently, with exposure to the south, to the fringe of (potentially) the noblest river in the country. The worst and poorest parts are at the north-east corner.

The true death-rate of a London district is difficult to get. The *British Medical Journal*, however, has been in the habit for the last nine quarter-years of publishing the "true" death-rates of the London districts after complete distribution of deaths occurring in public institutions. I have compiled a table from the nine tables which have appeared in the *British Medical Journal*, so that I am able to compare "The Strand" with the whole of London for nine quarters. and with Dorset (for ten years, 1871—80).

	Birth-rate.	Death-rate.	Zymotic death-rate.	Deaths under 1 year to 1,000 births.
London	32·5	19·9	2·7	151
"Strand," and St. Martin's-in-the-Fields	23·7	21·8	2·6	192
Dorset (10 years 1871-80)..	29·53	17·46	1·68	108

I have chosen the county of Dorset for comparison because it is a "healthy district," and if we are to do any good we must always aim at a high standard. Again, the Dorsetshire labourer has always been a favourite stalking-horse for cockney politicians, and it may be well to show how much healthier he is than the Londoner, notwithstanding his supposed condition of chronic starvation.

This table is very interesting. Dr. Letheby said "a high death-rate means a high birth-rate, and a high birth-rate is the invariable concomitant of prosperity." This dictum does not evidently apply to the Strand.

Dr. Farr, on the other hand, pointed out that "a low birth-rate implies a small proportion of young adults and a large proportion of the aged." This dictum again does not apply to the Strand, as we shall see by a reference to the next table, in which I have endeavoured to make corrections for the abnormal age-distribution which obtains in that district, and which Dr. W. Ogle rightly insists is absolutely necessary before you can arrive at just conclusions.

The table, I think, speaks for itself.

"*The Strand*"—*Mean population* 1871–80 = 37,461.

AGES.	Actual numbers living at each age.	Normal age-distribution for a population of 37,500.	Difference (+ & -) between actual and "normal" numbers.	Actual deaths in 10 years, 1871-80.	Deaths which would have happened if the distribution of ages had been normal.	Death-rate at different ages.	Death-rate of Dorset	Deaths which would have happened if the death-rate of Dorset had obtained in the Strand.
Under 5	3597	5100	—1503	3596	5100	99·97	40·07	1440
5—10	3134	4500	—1366	390	548	12·44	4·31	129
10—15	3069	4012	— 943	163	212	5·31	2·79	84
15—20	3824	3640	+ 190	317	299	8·29	4·43	167
20—25	4426	3337	+1089	366	273	8·27	6·65	290
25—35	6773	5513	+1261	963	770	14·22	7·50	510
35—45	5121	4237	+ 884	1246	1000	24·33	10·48	525
45—55	3935	3225	+ 710	1338	1088	34·00	13·04	520
55—65	2311	2212	+ 99	1147	1100	49·63	24·56	565
65—75	1003	1237	— 234	754	900	75·17	55·28	550
75	268	487	— 219	425	774	158·58	151·71	403
	37461	37500		10705	12064			5183

From this table it appears that there was in the Strand during the decade 1871-80 a deficit of 3,812 children under 15, and of 453 of persons over 65, while there was a surplus of 4,233 persons between 15 and 65.

This abnormal distribution ought, according to Dr. Farr, to give a high birth-rate, and a low death-rate. The very reverse is the case, and a critical examination of the figures seems to show that the death-rate in the Strand *is more than double what it is in Dorsetshire.*

It may be said that this high death-rate is due to the presence in the Strand of two hospitals (Charing Cross and King's College), and doubtless these have some material effect in producing the terrible adult mortality.

Hospitals however are generally placed where they are most needed, and I would point out that these institutions can hardly account for the enormous infant mortality; and certainly not for the deaths of infants under one year. Against the fact that the Strand contains two hospitals, is to be placed the not less important fact that it contains no workhouse. This institution is at Edmonton, where it helped to raise the death-rate from 15.8 to 16.9.

It need not surprise us that a population situated in the very centre of the vastest city the world has ever seen should have a high death-rate, and it may be well to look to the causes of death and again to compare the rates from different causes with those in Dorsetshire.

Death-rate from different causes.

	Strand.	Dorsetshire.
Whooping cough	0·62	0·29
Tabes	0·28	0·18
Phthisis	3·65	1·72
Hydrocephalus	0·61	0·22
Respiratory disease	5·92	3·15
Total of Tubercular and Respiratory disease	11·08	5·56
Small-pox	0·11	0·09
Measles	0·36	0·20
Scarlet fever	0·49	0·33
Enteric	0·38	0·19
Violence	1·61	0.49
Diarrhœa	0·92	0·35

No good would be got by extending this table. Suffice it to say that there is no single cause of death in the Registrar-General's tables which is not more active in the Strand than it is in Dorsetshire.

I would particularly draw attention to the fact that the death rate for whooping cough and tubercular and respiratory

diseases for the Strand is more than double that of Dorsetshire, a fact which is not to be wondered at in a population, the bulk of whom only breathe pure air upon the rarest occasions, and who habitually breathe an air so foul that the sun often fails to penetrate it, and which is fatal to almost all flowers and a large proportion of trees.

To me one of the saddest indications of the dismal state of this overgrown city is the appeal, which is now so common in the newspapers, for funds to give poor London children *one* day in the country, with of course the not immaterial deduction of the hours spent in going and returning.

These tables may serve to dispel another popular fallacy, viz., that the sulphur-laden air of London has antiseptic powers, and helps to check zymotic disease.

As a fact those zymotic diseases which presumably travel through the air (Small-pox, Whooping Cough, and Measles), are particularly rife in London. The death-rate from these three causes was during 1871-80:—

	In London.		Dorsetshire.
Small-pox ...	0·44	...	0·09
Measles ...	0·51	...	0·20
Whooping cough	0·81	...	0·29
	1·76		0·58

In fact the mortality caused probably by air-borne germs was exactly three times as great in London as in the healthy country district which I have chosen for comparison.

I have endeavoured to show that the admixture of water with putrescible matter is inadmissible.

1. Because it is antagonistic to a law of nature, encouraging putrefaction and delaying nitrification, and there can be no successful antagonism to nature.
2. Because the putrefaction set up in cesspools and sewers by mixing water with putrescible matter has been a direct cause of much disease.
3. Because the practice involves the most perfect dissemination of disease particles, and a neglect of the great principle, "*principiis obsta.*"
4. Because it is the great cause of the fouling of rivers and wells, and makes the obtaining of pure water increasingly difficult.
5. Because it is financially and economically disastrous, crippling the ratepayers and exhausting the land.
6. Because it is one of the chief causes of overcrowding, the greatest of all sanitary evils.

It may be asked, "What useful purpose can be served by talking thus to an audience of Londoners? London is hopelessly committed to the principle of water-carried sewage, and must make the best of it."

To this I reply that even London need not needlessly increase her already insurmountable difficulties, and that happily the whole of England is not yet quite absorbed into London and other cities. There is a very general belief throughout the country that because London has adopted the system of water-carriage it must therefore be the best. This idea is unthinkingly adopted, and to its adoption the distinction of borrowing and disbursing a large amount of other people's money acts as a spur. There has come within my own knowledge the case of a country town, in the midst of a poor agricultural district, which clamoured for a "sewage scheme" for the purpose of polluting its sparkling water-course, where anglers pay large sums for the privilege of trout-fishing; its death-rate being at the time between 16 and 17.

In the Thames Valley, the region of villas and market gardens, a whole crop of "sewage schemes" have lately been put forward, notwithstanding that the more rational methods of sanitation would be easier and cheaper.

Only the other day I visited a lone farm-house which a friend wished to take for the summer, and I found that the proprietor, having taken the soil-pipe of a recently erected water-closet into a cesspool alongside a deep well sunk in the chalk, had rendered his house unlettable to any thinking person; and lastly I heard last week of a friend who took a moor in Scotland, and wished to have rational methods of sanitation, but the noble owner, bitten by the modern craze for water, would allow nothing but water carriage, and accordingly laid his filthy pipes to foul the babbling highland burn, and deprive the soil of that of which it was in need.

Again, in institutions such as workhouses, barracks, schools, and the like, water-carriage is often adopted, notwithstanding the favourable conditions for rational methods. The ignorance of soldiers in this matter is an acknowledged cause of the sickness and mortality during campaigns.

There seems in short a very great necessity for directing attention to the "shortcomings" of water-carried sewage.

What do you propose? will be the next question. My answer is fair play and no compulsion.

Much as I believe in the good of spreading sanitary knowledge, I have little faith in the efficacy and a potent belief in the dangers of sanitary legislation whereby blunders are stereotyped.

The first thing necessary is an equitable adjustment of sanitary rates.

Borrowing for the purpose of constructing sewers should be disallowed, and those who do not need the sewers should not be called upon to contribute towards them, at least not to the same extent as others.

The present inequitable adjustment of sewer rates, is a premium on jerry-built houses without curtilage. Encourage the man who has a little bit of garden to make use of it.

Enforce the Pollution of Rivers Act against individuals, even against proprietors of highland moors.

Let us have a real inspection of nuisances and a harrassing of evil doers, and let us discourage by every means in our power the building of houses side by side and almost back to back, with no outlet but a hole.

Let water be paid for by meter.

I have every sympathy with the agitations of getting allotments for the poorer classes. The best and most economical allotment is one close to the house where refuse may be buried and in due time bring forth.

Those who advocate "sewage farming" tell us that an acre is necessary for every 100 inhabitants. How infinitely better if the 100 people could absolutely live on the acre of ground in (let me say) 20 cottages, each cottage having $\frac{1}{20}$ of an acre. How infinitely better for the man to till this little plot in his spare time, than to occupy his leisure by braying politics in a public house.

Let us calculate the produce of this plot of ground in terms of potato. An acre of a field will produce an average crop of 7 tons; the twentieth of an acre would produce 7 cwts., or 784 lbs. As these would be for home consumption, and would save the man from disbursing money at a retail shop, we may take the value at the average retail price of 1d. per lb., or £3 5s. 4d., or for the sake of simplicity say £3. To give $\frac{1}{20}$ of an acre to every five inhabitants would make a town inconveniently big it may be said. I think not; 100 to an acre is 64,000 to a square mile, or making a very liberal reduction for space occupied by roads, let us say 50,000 to a square mile. This does not sound like an inconvenient scattering of houses. The inhabitants would make £30,000 a year by the produce of the land, a gain of which Free Trade could not deprive them; and there would be no sewer rate, no plumbers' bills, and certainly a vast increase of health, happiness, and contentment.

What I am advocating is no utopian scheme, and I am not talking without some practical experience. A few years ago I bought twenty cottages adjoining a garden which I have in the

country. Many of them had been built with a very insufficient curtilage, and their old fashioned sanitary arrangements made the garden anything but pleasant. My first step in improving these cottages was to do away with the old fashioned pits, which were not suited to the low-lying spot and were always full of water, and replace them by pails. The cottages are systematically scavenged every day, and all refuse, inclusive of food refuse, excrements, and ashes, are buried immediately in the garden. There has been a complete cessation of all offence, and my garden holds the proud position of being certainly one of the most fertile in the district. Roses and other flowers, and all the ordinary garden fruits and vegetables, flourish therein in great luxuriance. The æsthetic aspects of the place have been increased, and in no way diminished, by the course I have pursued. I wish it to be understood that I am no mere theorist, but that I practice what I preach.

I have dealt with this subject from rather a different point of view in a little book, "Our duty in regard to Health," which I wrote for the Council of the Health Exhibition. Those who may care to pursue this subject further, may get the book of Clowes & Co., the publishers, at Charing Cross.

Congresses held by the Institute.

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EXETER, 1880.

President.

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YORK, 1886.

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BOLTON, 1887.

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CONGRESS AT BOLTON.

INTRODUCTION.

The tenth Congress of the Institute was held at Bolton, from Tuesday, September 20th, to Saturday, September 24th, by invitation of the Town Council.

Very suitable accommodation was provided for the Meetings of the Congress in the Town Hall. The Opening Address of the President, Right Hon. Lord Basing, F.R.S., and the Addresses to the Working Classes, were delivered in the Large Hall (Albert Hall). The Lecture to the Congress and the Meetings of the Sections were held in the Council Chamber and Borough Court, and the Conference of Medical Officers of Health in the Grand Jury Room; the Reception Room and Offices were also provided in the Municipal Building. The Exhibition was held in the new Drill Hall, to which a special annexe had been added.

The Members of the Congress and Visitors were received by the Mayor in the Reception Room, after which a Public Luncheon was held in the Albert Hall: more than a hundred people were present. The Company then proceeded to the Exhibition, and were conducted round the building by the Judges: the Exhibition was then finally declared open by the Mayor.

The Exhibition was continued till October 23rd, and was visited by about 27,000 people; there were 112 Exhibitors. The Judges awarded 6 Medals and 8 Special Certificates, and 30 Certificates. 56 Exhibits were selected for further practical trial and testing.

The business of the Congress was divided into the usual three Sections, viz., Section I., Sanitary Science and Preventive Medicine; Section II., Engineering and Architecture; Section III., Chemistry, Meteorology, and Geology. The Papers and Discussions in Sections I. and II. occupied two days each; one day was also devoted to a

Conference of Medical Officers of Health, which had been held successfully for the first time in connection with the Congress at York on a somewhat smaller scale.

A Record of the Sectional Meetings and the Conference is given in the Reports of the Secretaries on page 469.

A Conversazione was held on Wednesday evening, when about 450 people were present; the Mayor and Mayoress receiving the Guests.

Addresses to the Working Classes were given on Saturday evening by Major Lamorock Flower, Mr. Wynter Blyth, and Mr. H. Law, m.inst.c.e.; the chair was taken by the Mayor.

On Saturday an excursion was made to the various reservoirs and works for the Water Supply of Bolton; the party being guided by the Chairman of the Water Committee and other Officers.

During the Congress, several visits were arranged to the Fever Hospital, Cotton Factories, Coal Mines, and other places of interest in Bolton.

E. WHITE WALLIS,

27*th March*, 1888. *Secretary.*

Officers of the Congress.

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INAUGURAL ADDRESS

Delivered 20th Sept., 1887,

BY THE RIGHT HON. LORD BASING, F.R.S.,

PRESIDENT OF THE CONGRESS.

IT will be readily understood that in accepting the Presidency of the Sanitary Institute for the current year, I had no intention of addressing you on the medical or scientific aspects of the subject matter with which we have to deal. Indeed, when my friend, Sir Douglas Galton, did me the honour to express a wish that I should undertake it, I made it an express stipulation that I should not be expected to go *ultra crepidam*, nor to vie with my learned and distinguished predecessors—himself not the least eminent—who have now, through a series of the last ten years, enlightened their hearers in all quarters of this kingdom, and their readers in all parts of the world, by elaborate papers illustrative, from various standpoints, of sanitary science in its relation to the Public Health.

My own connection with sanitary science is exclusively that of the politician, whose experience as a responsible legislator has been mainly engaged in the improvement of our sanitary laws, and who, as an administrator, has been employed in the, perhaps, more difficult task of watching their working and developing their usefulness. Though I speak with much diffidence of my own share in these duties, which could not have been discharged without the consummate knowledge and trained experience which are at the disposal of anyone who occupies the position of President of the Local Government Board, it nevertheless happened that during the rather unusual period of six years, viz., from the formation of Lord Beaconsfield's Government in 1874 to the dissolution of Parliament and break up of that

Government in 1880, I became of necessity intimately acquainted with, and was responsible for, all that occurred in and out of Parliament in relation to the public health, and was so brought face to face with many problems, the conditions of which can scarcely be appreciated except by actual experience in the endeavour to find a solution for them.

Scanty enough seemed at that time the result of all our labours. Many disappointments occurred, and much that might have been advantageous was postponed through force of circumstances; but in comparison with the transactions of more recent Parliaments, one cannot but look back to it as a period of activity and of comparative success: one, moreover, in which many useful lessons were to be gathered from the occasional clashing of the claims for scientific perfection on the part of what I may call the professional expert, with the exigencies of practical politics. Some of the considerations thus arising may perhaps be appropriate to this opening of our tenth conference, and must certainly, in all justice, be taken into account if we desire usefully to compare the shortcomings of the past with the achievements of the present, and with the needs of the future.

One of the shortest paragraphs of the Report of the Royal Sanitary Commission (to which I shall presently refer in some detail) is couched in the following terms: "Inducement should be provided for the study of State medicine, which may be defined as the application of the physical and medical sciences to the preservation of the health of the community at large. It includes (*a*) medical jurisprudence; (*b*) vital and sanitary statistics; (*c*) preventive, as distinguished from curative, medicine."

It seems to me that the time has arrived when we may fairly ask ourselves what progress has been made in this direction, whether there is now a school or study of State medicine, and whether we have actually, or potentially, a Minister and a Government Department of Public Health; but, in the first instance, I propose to examine very shortly the history of the statutory and other steps which have been taken of late years in relation to the subject.

The first sanitary legislation to which we need go back is that which culminated in the Public Health Act of 1848. The early public statutes of the reigns of Richard II., Henry VI., Henry VII., and Henry VIII., to which reference is sometimes made, had little in common with what we now understand by that term; but there is no doubt that from the reign of George II. onwards, the growing wants of populous towns caused their various governing bodies to apply to Parliament for private or special Acts, in order to gain powers for

improving the sanitary condition and supplying the essential health-requirements of the inhabitants; so that the stir of public alarm which followed the outbreak of cholera in 1831, and which brought into existence a variety of administrative and Parliamentary activities, found some useful precedents already established for their guidance through the self-governing instincts of the greater municipal organisations. Cynical experts may smile or point their moral, but, after all, what basis for legislation is more legitimate, or more characteristic of our English methods of proceeding, than the lessons of experience? These must not only be collected and expounded by experts and assimilated in the mind of the statesman, but must be brought home to the convictions of the people before they can be accepted or submitted to in the shape of positive enactment. But, however that may be, it is certain that the period between 1832 and 1848 was marked by the passing of the Quarantine Act of the former year; by the Lighting and Watching Act of 1833; by the great Municipal Corporation Act, 1835; by the Improved Registration Act, 1836; by important reports of the Poor Law Commissioners; by Parliamentary enquiry into causes of disease and of excessive mortality; by Mr. Chadwick's well-known report to the Poor Law Board, 1842; by the Royal Commission presided over by the Duke of Richmond in 1843—1845, and its results in the Nuisance Removal and Diseases Preventive Acts, 1846; and in the Town Improvement Act, 1847; and finally by the Public Health Act, 1848.

The second outbreak of cholera occurred in 1849, and was followed very naturally by attention given on the part of the legislature to such subjects as common lodging-house regulations, and improved water supply, while progress was made under the facilities of the Public Health Act 1848, in the carrying out of local works of drainage and sewerage.

The third visitation of cholera occurred in 1854, and was followed by conspicuous activity in parliamentary dealings with nuisance removal and disease prevention by the Acts of 1854 and 1855. The latter year was made for ever memorable by the first appointment of Mr. Simon, now Sir John Simon, to the office of Medical Officer to the Privy Council. His ability, energy and strong convictions caused him to play a most conspicuous part in all that was done during his régime in connection with these matters, while he may be fairly said to have revealed the true origin and nature of typhoid fevers by his Reports and Essays.

The establishment of the Metropolitan Board of Works in 1855, with new and comprehensive powers for the main

drainage of London superseding those of numberless vestries is, probably, (imperfect as many now think it) one of the most important improvments of the last half century. And the Local Government Act 1858, with Amending Act of 1861—1863, the Diseases Prevention Act and Nuisances Removal Acts which followed, bring us down to the important epoch of 1869, which was marked by the appointment of the Royal Sanitary Commission.

Royal Commissions are favouritive methods adopted of late years by over worked or timid governments, in order to prepare the way for action on subjects of doubtful popularity, and it is to be feared that without such preparation of the public mind Parliament would never have been brought to sanction much of what we now regard as essential and matters of course.

Of all the Royal Commissions which have been thus constituted in our times, few have been more ably manned than this, and none have been so directly and immediately successful in their result, for within the short period of five years almost the whole of their wise and well considered recommendations were carried into effect.

Of this commission and its consequences I will now give a short account, for the particulars of which I am in great part indebted to my friend and fellow worker Sir John Lambert, who has been for many years one of the ablest of our admirable civil servants, and the trusted adviser of successive governments, no matter what their politics, in almost every department of home administration.

The Royal Sanitary Commission was appointed in 1869, and the Commissioners made their report in 1871.

There were twenty-one Commissioners, five of whom were eminent medical men.

The objects of the Commission were:

(1) To inquire into and report upon the various sanitary statutes, with a view to their consolidation and amendment.

(2) To inquire into and report upon the constitution of the several existing sanitary authorities, with a view to the establishment of an efficient sanitary authority for every sanitary area in the kingdom without any overlapping jurisdictions.

The ostensible circumstances which led the Government to appoint the Commission, were the confusion arising from the large number of existing sanitary acts; the inadequate powers conferred by them; the inefficiency, in numerous instances, especially in rural districts, of the local authorities charged

with the administration of the law; the difficulties resulting from the administration of the law by three central authorities, viz., (1) the Home Office, (2) the Privy Council, and (3) the Poor Law Board.

The idea of the Commission seems to have originated with the medical department of the Privy Council, which had for some time been growing up in that office under the influence of the very active and intelligent medical officer (Mr. Simon), who naturally complained of the confusion of jurisdictions of the Home Office, Privy Council, and Poor Law Board, in sanitary matters.

The inquiry by the Commission was of a very exhaustive character, as will be seen by their elaborate reports, which were to a great extent the work of the chairman, Sir Charles Adderley (now Lord Norton), one of the first of our statesmen who grasped the necessity of improved sanitary legislation, and who lost no opportunity of pressing it forward in and out of Parliament. He was, however, assisted considerably by several of the members of the Commission, one of the most active of them being Mr. F. S. Powell,—well known, especially in Lancashire, for intimate knowledge of and interest in the subject,—now M.P. for Wigan, other conspicuous Commissioners having been Mr. Whitbread, Dr. Ackland, and Mr. Bircham.

The digest of the several sanitary acts appended to the report, and which was a work of great labour and importance, was, I believe, the work of Mr. Powell.

The chief recommendations of the Commission were:

(1) That there should be one central authority for all sanitary matters.

(2) That there should be one local sanitary authority, and one only for each sanitary area.

(3) That the law should be amended in certain particulars and consolidated.

The Report of the Commission was made in April, 1871.

In the June following, Mr. Stansfeld, the President of the Poor Law Board, brought in a Bill to give effect to the first recommendation of the Commission by establishing the Local Government Board, to which were transferred all the powers of the Poor Law Board, most of the sanitary powers of the Home Office and Privy Council, and the jurisdiction of the Home Office over the Registrar General.

This Bill became law on August 14th, 1871.

In the following year Mr. Stansfeld introduced another Bill, which he succeeded in passing, the effect of which was to divide the whole country into urban and rural sanitary districts, to establish one sanitary authority and one only for every such

sanitary area, and to amend the law in numerous important particulars.

(*a*) It compelled every sanitary authority to appoint a medical officer of health. In order to induce local authorities to appoint efficient medical officers of health and inspectors of nuisances, Parliament provided for repayment of a moiety of the salaries of these officers when the appointments had been approved by the Local Government Board.

(*b*) It provided for the appointment of Port sanitary authorities, to prevent the introduction of dangerous infections and contagious diseases from foreign countries.

(*c*) It authorised the union of districts and the constitution of joint boards, for works of sewerage and water supply, and for other sanitary purposes.

(*d*) It enabled the Public Works Loan Commission to advance loans for sanitary purposes at a low rate of interest ($3\frac{1}{2}$).

(*e*) It gave the central authority additional powers with respect to provisional orders, enabling them to dissolve, enlarge, or reduce local government districts by provisional order without consent.

(*f*) It also transferred to the Local Government Board the powers of the Board of Trade and Home Office, under the Alkali and Metropolis Water Acts, and the Highway and Turnpike Acts.

It was reserved for the government of Mr. Disraeli and for the Parliament of 1874, to carry into effect the most troublesome and, perhaps, the most important of the recommendations of the Commissioners, viz., the consolidation of the sanitary law, and this was accomplished partly through my humble instrumentality.

The Public Health Act, 1875.

This Act contains no less than 343 sections, and consolidates wholly, with a few exceptions, no less than twenty-two Acts of Parliament.

During the twelve years it has been in force it has required only a few comparatively unimportant amendments, and it may be said to contain the most complete sanitary code that is to be found in any country.

The consolidation of the law by this statute has been of the greatest advantage to all who are concerned in its administration, and has thus assisted materially in promoting sanitary improvement.

It may also be said that it has been uniformly well spoken of by the Judges, who are usually the most unsparing critics of the shortcomings and imperfections of Acts of Parliament as regards their language and drafting.

In addition to the authorities constituted by the Act of 1872, the Local Government Board have, under the powers confided to them by it, established a Port Sanitary Authority for every important port in the kingdom, so that the whole kingdom may be said to be surrounded by a *cordon sanitaire* to guard against the introduction of foreign epidemics.

As a proof of the impulse given by the Public Health Act to sanitary work, reference need only be made to the loans sanctioned for this purpose in the two years before the Act of 1872 came into operation, and in the two years after the Act of 1875 took effect.

Years.	Loans.	
	To Urban authorities.	To Rural authorities.
	£	£
1871—72	1,212,890	*Nil.*
1872—73	541,771	*Nil.*
1876—77	2,563,708	193,615
1877—78	4,182,627	196,972

One great improvement effected by the new legislation was the constitution of the guardians as the rural sanitary authority, and the foregoing figures show that as soon as they were invested with their new powers they began to undertake sanitary works.

Another proof of the activity of the new sanitary authorities is shown by the number of provisional orders issued in the three years before and the three years after 1875.

Date.	Orders.	
1870	35	134
1871	36	
1872	21	
1873	42	
1876—77	102	261
1877—78	81	
1878—79	78	

It is scarcely necessary to say that the provisional order system has been of great assistance to sanitary authorities in enabling them to amend or repeal their local acts, and to acquire lands compulsorily without being obliged to go to Parliament for a special act.

Since 1875 the Local Government Board have issued no less than 838 provisional orders, of which only 49 were opposed, leaving 789 unopposed.

The cost of a provisional order if unopposed is only a few pounds, whereas the cost of a private bill, even when unopposed, is very considerable.

If 600 private bills had been requested instead of these 789 provisional orders, and the average cost of each bill is taken at the low sum of £250, the total would have amounted to £150,000, all of which may be considered as so much saved by the Local Authorities.

The general results of the sanitary legislation referred to cannot be better summed up than by the following figures extracted from the Registrar General's last published report, which shew the average rate of mortality per 1,000 during each of the quinquennial periods, commencing with 1860 and ending with 1885.

Quinquennial Periods.	Ratio of Deaths.
Ending	Per 1,000 Population.
1865	22·5
1870	22·4
1875	20·9
1880	20·0
1885	19·3

So that since 1870, the annual death-rate may be said to have diminished by no less than one-seventh.

It thus appears that the three principal recommendations of the sanitary commission were completed within four years from the date of their report. But there were many other proposals put forward by them, some incidentally, some specifically, which it fell to my lot to deal with, and which became law during the earlier years of Lord Beaconsfield's Government.

Of these I may notice the Registration Act of 1874, which consolidated and amended the existing law, and introduced for the first time, what had long been a desideratum, the compulsory Registration of Births. Students of Dr. Farr's admirable

reports will readily understand how much that is of importance in a sanitary point of view is involved in this very legitimate piece of compulsion. The sale of Food and Drugs Act 1876 was likewise a measure of consolidation, and placed the law as to adulteration on a solid and satisfactory footing. The amended Alkali Act was of the same character, and the recent twenty-seventh report of the Inspector of Alkali Works shows it to be working well and giving satisfaction. The Rivers Pollution Prevention Act, which followed, was rightly regarded as a most valuable establishment of a principle which had long been advocated, but which could only be passed, so great was the apprehension it excited, under a form which left much freedom as to its administration in the hands of the Local Authorities. The time has certainly arrived when its provisions might advantageously be strengthened, so as to secure greater activity and vigilance in their enforcement.

And now, having wearied you by reading detail of what must be to many in this assembly already familiar, let us take stock as it were of the situation at which we have arrived, and ask ourselves the question, how far we have carried out the policy indicated by the phrase "State Medicine" as found in the report of the Royal Commission? In other words, how far does the legislation of the last thirty years supervised by a new department of State under a Minister of the Crown satisfy the public wants in this respect?

Here we are evidently face to face with two powerful currents of sentiment and opinion running counter to each other. On the one hand, the true born Briton is apt to resist and resent undue interference with himself, his personal freedom in things indifferent, and with the self-governing authority of which he is a member or an elector. On the other hand there is certainly a growing tendency to look to Government for help, for direction and for pecuniary assistance in the hour of difficulty and danger, and, moreover, to hold the Government responsible for all calamities which occur, local as well as imperial.

The Local Government Board has in its President a responsible Minister, who is surrounded by a most able and active body of Officers and Inspectors,—medical experts, through whose agency he may well regard himself as the Minister charged with the care of the public health. Through their activity and intelligence, much of the knowledge which is now at the service of the world at large has been collected and disseminated: their advice is constantly needed and eagerly sought by Local Authorities, while the scientific treatises which through their labours have been published from time to time,

form the text-books of the medical profession in regard of public health, and are freely accepted as authoritative on that subject. From their point of view, all that has yet been accomplished is trifling in comparison with that which ought to be done, in the way of watching the public health, of keeping the department abreast of the latest phases of disease and their attendant phenomena, of collecting new facts, and of making known the new conditions which they illustrate, or the conclusions at which they point. More inspectors, more references, more reports, more public expenditure, a more clear recognition by a more definite title than at present of the functions they discharge, and of the Minister under whom they work,—these are the underlying principles which seem to have prompted their action hitherto, and to constitute the ideal at which they aim. But Parliament and the public will not readily accept contentions such as these without demur. For what purpose have local areas been set out, and local authorities established and furnished (partly at the cost of the State) with Medical Officers of Health, with Inspectors of Nuisances, and the like, if it was not to render them self-sufficient and self-reliant in the discharge of their duties? and to what end has information been laboriously collected at head-quarters, if not for the training and guidance of local administrators? By this time—it may be urged—after fifteen years working, the principles thus laid down have become widely known, the practise of the Department is familiar in all urban and sanitary districts, and the time has surely arrived for relaxing rather than strengthening the curb, and for moderating rather than stimulating the central pressure. There is, of course, no finality in legislation, and, as I shall presently show, there is urgent need for going forward in that, and in the correlative work of administration; but due recognition must, in fairness, be awarded to the activity which has distinguished the sanitary reforms and improvements of the past generation, and the public has a right to expect that the local officers who serve them, and the restraints to which they, more or less cheerfully, now submit, shall operate within their respective areas, as a real public health and state-medicine department, on which reasonable reliance can be placed. There arises beyond this a further interesting reflection, which I commend for discussion, viz.: how long, and to what extent, will the medical profession be satisfied to sit at the feet of Gamaliel in Whitehall, and to accept without question the enquiries and reports published at the public charge by persons who, as time goes on, will be under the disadvantage of standing more and more outside of the regular practice of their profession?

These are considerations which may well be submitted on occasions like the present. The Sanitary Institute has now, after the test of ten years' successful working, become recognised, and takes its place among the more important of the Societies who have constituted themselves in this country as volunteer agencies in spreading useful knowledge, and popularising the results of science with a view to their practical application.

It does not lie in their mouth to dispute the importance of encouraging self-reliance and a sense of responsibility on the part of localities. One of the most important of their self-imposed functions is to assist in the special education of health officers, and to award certificates of skill and proficiency which may be of value to the recipients, and give confidence to their employers. It is not many years since the Society of Arts gave similar certificates of general educational acquirement, thus pioneering the way for training colleges and university examinations, through which such objects are now more generally and systematically carried out. On the other hand there need be no fear, and there should be no suggestion, that they would ever be parties to a lowering of the scientific standard; and I think a fair balance of opinion might be gathered from a candid discussion of the subject in these assemblies.

For my own part I do not wish to appear before you as an optimist or as a pessimist—certainly not as an optimist. Passing by for the moment the question of the standard or ideal at which we should aim, I find plenty of material for legislative change, and improvement stored up in various ways, and ready to be put forward when time can be afforded for anything except questions affecting the condition of Ireland. The more urgent of these points (of which I shall presently give a catalogue) have been derived by what I have already described as the most legitimate and satisfactory of all methods, viz., from the applications to Parliament on the part of private bill promoters, mostly our larger and more populous cities and towns, during the last six or eight years. I have twice during that period acted as chairman of the Parliamentary Committees to which the more important of these Improvement bills have been referred; referred, however, with the view of curtailing rather than encouraging exceptional legislation, and of moderating the tendency to extravagant expenditure by means of borrowed money. Many of the provisions mentioned in the list have been conceded, others are so far recognised as needful to be provided that they will undoubtedly be included in the next, nay I hope, the approaching amendment of the Public Health Act 1875.

I well remember, amongst the most remarkable and compre-

hensive of the applications which have been made to Parliament of late years, an elaborate consolidation and amendment of the Bolton Improvement Act, which, together with some others of the like authority, has exercised no small weight in the process of selection to which I have alluded.

Sanitary Laws.—Suggested Amendments.

Although the Public Health Act 1875 may be said to be complete as a general measure, so far as regards the accepted sanitary requirements at that time, subsequent experience has shown it is now capable of amendment in several important particulars.

The following are some of the amendments which have been suggested:—

1. The importance of separating sewage from surface water is now recognised.

The act is, in its present form, practically prohibitive of schemes for that purpose; and power is therefore wanted to enable local authorities to provide a dual system of drainage. The Corporation of Reading were so sensible of the importance of this arrangement that they were mainly induced by a consideration of it to promote their local act of 1881.

2. Provisions are needed to prevent injury to the structure of sewers and their obstruction, and the evolution from them of specially noxious vapours from chemical works, &c.

3. It has been frequently urged that communications between drains and sewers should be undertaken by the local authority, at the cost of the owner, instead of by the owner. The central authority should be empowered to decide upon the junction of the sewers of one authority with those of another.

4. Local authorities might have power to regulate in addition to materials, size, &c., the ventilation and height of sleeping-rooms, trapping, junctions of drains, &c., in connection with dwelling houses. More powers are also needed with regard to enforcing the repairs of vaults, &c., under streets. Provision is also needed for the regular inspection of houses during their construction to see that proper materials are used.

5. Provisions would seem desirable for prohibiting the construction of rooms over privies; and power might be given to impose a penalty on persons who, after notice, neglect to repair or cleanse their closets or ash-pits.

6. A local authority, who undertake or contract for the removal of house refuse, cannot make bye-laws relatively to such removal. They should have power to make bye-laws ancillary to the work so undertaken by them or their contractors.

7. Larger powers should be given to sanitary authorities for the protection, both within and beyond their limits, from pollution of water courses from which they derive their water supply; and lords of manors might be empowered to make grants of waste lands for purposes connected with water supply.

8. Parliament has very generally accepted in local Acts proposals for the prohibition of the use as dwellings of premises constructed, and ostensibly intended, solely for use as "lock-up shops." There might now be a general enactment to this effect.

9. A local authority should have power to cancel the registration of a common lodging house. They cannot do so now.

10. Back-to-back houses should be prohibited in future.

11. Power should be given to proceed against offenders when the article of food has been found unfit for use after it has been sold, or where it has not been exposed for sale but delivered under contract.

12. Many local Acts empower the local authority to disinfect houses. This might now be made general.

13. A considerable number of local authorities have obtained Acts enabling them to require medical practitioners to notify any occurrence of dangerous infectious disease. This matter has been the subject of much controversy, and, perhaps, we must look forward to a fourth epidemic of cholera before it can become general law; but the time has arrived when facilities should be given to the central authority to clothe local authorities with this power on application, so that they need not incur the expense of a local Act for the purpose. I am happy to know that in Bolton this provision of law exists and works well.

14. Sanitary authorities should be authorised to issue notices and advertisements warning the inhabitants against conduct likely to spread infectious disease.

15. It is desirable that some power should be given to remove to hospitals persons attacked with infectious disease, when isolation is not otherwise practicable.

16. Local authorities should be enabled to provide temporary shelter for members of a family in which infectious disease has appeared, whilst the house is being disinfected and cleansed, and to provide nurses for attendance upon persons suffering from infectious disease.

17. A penalty should be imposed on persons ceasing to occupy houses where there has been infectious disease without previous disinfection or notice to owners, or for making false answers.

18. Bodies of persons dying in hospital of infectious disease not to be removed except for burial, and corpses not to be carried in public conveyances other than hearses.

19. The medical officer of health should be empowered to enter a house where he has reason to suspect the existence of infectious disease on obtaining a magistrate's order.

On the other hand I certainly do not wish to appear before you as a pessimist, and I feel bound as the final result of my experience, such as it has been, to say, that, having regard to the comparative novelty, and to the difficulty and obscurity of the subject, to the natural dislike of control, and to the great expense attending works of sewerage and water supply charged exclusively on the occupier; still more, when we remember the disinclination of Parliament to turn aside from the more striking and generally interesting matters which make or mar the fortunes of Governments and Parties, I feel more than satisfied, on looking back over a period of thirty years, to find that so much solid and substantial improvement has been really accomplished. At this moment, my principal apprehension undoubtedly is, that in the anxiety to escape from the irksomeness of detail, and in the hurry to establish Local Government generally on a wider and more popular basis, mischief may unwittingly be done through misappreciation of the difficulties under which that which now exists has been built up, and of the great risk which may be run if such central control as is really still required, were to be hastily surrendered.

But, further, that a pessimist view is in fact unjust and untenable, statistics abundantly prove. I have already given more than sufficient for my case, but I will take the liberty of borrowing, what I am sure our veteran champion Mr. Chadwick will readily lend, a few of the more striking illustrations which he gave to the world on a recent occasion when celebrating the Jubilee of Sanitary Science.

"The present reduced annual death-rate for the metropolis may be stated at 19 in 1000, but the sanitary engineer could undertake its reduction by 5 in 1000, and at a cost greatly below the existing insurance charges for sickness, loss of work, and death. On what experiences, it may be asked, are the statements as to that conclusion based? The answer may be, that they are based on that which has been done for the common lodging-houses—old buildings, once the seats of pestilences, but now cleared of them by very rudimentary sanitary measures; on what has been done in blocks of buildings in the metropolis, and in old urban districts, such as Salisbury, where the death-rate, as high as 40 in 1000, has been reduced to 16 in 1000; in Dover, where 28 in 1000, is now about 14; in Rugby, where 24 in 1000, is now under 12; in Croydon, where 28, is now 10 to 15; in Matlock, where 18, is now 9."

Mr. Chadwick then proceeded to make some remarks leading

up to the important subject of the economy of sanitation which he has recently worked into shape, and which I trust he may be able to lay before this conference, no aspect of it being more likely to influence the popular imagination.

These and similar statistics have been put before the Sanitary Institute by Presidents and other speakers year after year, but they cannot be repeated too often. The period of activity is too soon followed by a relapse into apathy, and even when, through the agency of epidemics or other exciting cause, the time for constructive legislation comes round again, we shall find that the growing tendency to disparaging and fault-finding criticism on the part of public writers and speakers, coupled with the spirit of obstruction which now seems to be paramount in the House of Commons, will render the task of the Government increasingly difficult. They will accordingly require all the backing which public opinion can confer, enlightened as it must be by efforts such as this and other kindred associations are making, to carry them safely through the rocks and quicksands which will most assuredly beset their progress.

The address which I have thus ventured to lay before the Congress, has been couched, for the most part, in abstract terms. But we must not forget that we are meeting in one of the most thriving industrial centres of the great County of Lancaster, and I trust that considerable attention will be given to the application of sanitary science to the needs of the populations which have grown up in these manufacturing districts.

The cotton manufacturers have exercised no small influence in times past over the financial policy of the country. If the wealth and prosperity which followed, and, in some degree, flowed from that policy have caused an aggregation of human beings in and about the central towns to multiply with a rapidity and to an extent prejudicial to healthy conditions, it is here that we should look for activity in remedial measures, and a ready recourse to all that can be done in the way of amelioration.

Can it be said that the existing state of things is perfectly satisfactory? Is not the death rate higher than it should be, and that, even in Bolton, which is more healthy than many places that might be named hereabouts? Does it not, for instance, compare unfavourably with that of London? and, if so, do we find earnestness and discrimination on the part of the local authorities in pressing forward remedial measures, and acquiescence on the part of the people in submitting to the necessary expense?

I have referred to the Bolton Improvement Act; but there are few towns of any size in the County Palatine which are not

provided with similar facilities in the same way, and all are subject to the provisions of the Public Health Act, which, in the greater part of Lancashire, is doubly effective, as the sanitary districts are mostly of an urban character.

In fixing their Congress at Leicester the year before last, the Sanitary Institute was not afraid to beard the lion of Anti-Vaccination in his den; (to little purpose, I fear, if the statements of a letter in the *Times* of September 19th, 1887, are well founded). Let it not be said that we come only to prophesy smooth things at Bolton. We know the energy and capacity of the Lancastrian population. We must not shrink from holding up before them the highest ideal; and I may add, the material advantages which are involved in determined efforts after sanitary improvements. Thus our visit to the north may become, as we should desire, a useful stimulus locally, as well as a signal manifesto of the principles we profess, and of the great national objects we have in view.

SECTION I.

SANITARY SCIENCE & PREVENTIVE MEDICINE.

ADDRESS,

By J. Russell Reynolds, M.D., F.R.S., F.R.C.P.

PRESIDENT OF THE SECTION.

The causes of disease, with which preventive medicine has to deal, are so numerous and so various that it is, first of all, necessary to arrange and classify them in some logical order. This I have attempted to do in the scheme which follows, premising that it is of provisional character only, and may be found useful as a working assistant until something better is propounded to take its place.

1. The first division is between those which are inherent in the individiual and those which are brought to bear upon him from outside. In the former category are to be found hereditary constitution, sex, age and temperament; in the latter, all those influences which disturb the balance of income and expenditure of both material or ponderable, and of immaterial or imponderable elements.

Every one has his life conditioned by the former. There is no possibility of eradicating the conditions, or of modifying them, when once developed in an individual; but their effects may be prevented from becoming disease, by timely recognition and counteraction. Every one, on the other hand, requires for the healthy performance of vital functions, an equilibrium between the income of material—in the form of food, air, and the like—as well as the income of heat, light, and other forces, and the expenditure or excretion, or going out of material, and of energy.

Income may be wrong in quantity, or unwholesome in quality, while outgo may be at the same time defective; and so to the introduction of new poison from without is added retained poison from within. It is by the recognition of these causes of disease, and the employment of all our antagonistic powers,

that preventive medicine may presume to be scientific in its method, and successful in its results.

The first of the inherent causes of disease is—

A. Heredity. There are many conditions passed down from one generation to another that are not morbid, such as configuration, height, mental and moral qualities, which are said to "run in families," but with which we have nothing to do here. But there are others which are morbid, the influences of which we have to cope with, and if possible to intercept. They may be arranged under the heads of (1) redundancy or (2) deficiency of organs; (3) arrests of development; (4) unhealthy conditions of function or structure of particular organs, or systems of organs; (5) disturbances of the whole body, diathetic, constitutional diseases, the tendency to which does or does not show itself until different epochs of life, when specific trophic changes occur; and (6) special proclivities to "take diseases" coming from outside; and conversely, insusceptibilities of analogous kind which latter cannot be regarded as morbid, but which may sometimes prove traitorous if relied upon too implicitly.

Speaking generally the power which the physician has to diminish hereditary disease lies in two directions (*a*), the forestalling of morbidity by the prevention of ill-assorted marriages; and (*b*), the special guidance of tainted children, by all measures that can be used or devised for the purpose, by controlling moral, mental, social, and physical education, and regimen of life. This must be commenced before birth, continued in the nursery and schoolroom, and maintained during manhood, and even to declining years.

a. Marriages of consanguinity, even when there may be the very rare event of freedom from all taint on either side, are well known to become, in the second, third, or fourth generation, the source of much deformity and misery; and this in spite of all special statistics to the contrary. Marriages of consanguinity unfortunately "run in families," and so intensify the evil; and they are doubly difficult to circumvent, first because of the primary bias to their contraction, and then because the poor creatures thus produced are specimens of Nature's workmanship in its most untidy mood; features have rarely been duly chiselled; the sense of beauty has long been dead; while gauche figures and manners often render the victims little short of repulsive to all but those who, born under like conditions, have their faculties of perception so maimed and blunted that they know no better, and are also debarred by their own defects, from making any higher choice.

This is but a feeble account of what occurs too frequently

when some distinct hereditary taints do exist in a family, and where marriages among its members have been permitted. Definite disease, as well as deformity, is the too frequent result; and the result is both persistent and aggravated until, happily, sterilisation may set in. No one can doubt the power of "artificial selection" in the production and perpetuation of advantages or peculiarities that may have been accidentally or artificially brought about. No one can doubt the force of "natural selection" along the lines of utility and the most consummate art; and no one can fail to see, or ought to fail to see, that there exists in man the power to modify the race to which he belongs; and acting up to his highest light, in all the paths of knowledge, to use his art to diminish or destroy that which has within it, at its beginning, the seeds of its own inherent decay, being assured that if he does his work well, nature will internally perform the rest. Conversely every change, accidental or inherited, which limits the capacities of life, is liable to become fixed by transmission through successive generations.

But (*b*) there are marriages taking place daily, not those of consanguinity, but of unhealthy people, and of those who are actually suffering from developed disease, of marked hereditary character, or from as yet undeveloped taint, and this often happens when the taint is very strongly exhibited in other members of the family. Let it always be remembered that hereditary taint, although undeveloped, is in itself disease, and then the grave character of the responsibility of propagating it may be, if not duly, approximately gauged. The function of the physician is to examine carefully, and advise discreetly. He must weigh *all* the parts of the family history,—and here he will meet with the greatest difficulty, for often the facts are not known, or, when known, are either concealed or misrepresented. He must form an opinion of the intensity of the hereditariness in each particular malady, and also in the family under consideration; and he must have the courage of his convictions. This may make him unpopular or hated, but he must be strong enough to do his duty, and find, in doing it, his reward.

But it is in a very small minority of cases that preventive medicine is ever called into operation in this early stage. The minority is as small as the majority is vast in which the physician is consulted before disease has advanced into open and obvious activity.

The devices that must be employed to prevent the development or further progress of inherited disease, are as manifold as the affections themselves, and some further insight into the

prevalence of the latter may be gained by a simple enumeration of those which are the most familiar. But here let me make two remarks by way of caution. First: there is no disease that has yet been shown to be *always* hereditary in its origin, so that, *e.g.*, when we meet with insanity or phthisis in an individual we are not, at once, to conclude that it was "inherited" by him because a parent had been epileptic, or a grand-parent had died of consumption. A large proportion of hereditary diseases can be traced to no hereditary source in particular individuals, therefore we must allow that, in a large number of cases where the possibility of inheritance is patent, a certain number may have developed the disease *de novo*. Secondly, with regard to many people the anti-hygienic conditions and habits which have led to disease in their ancestors may be persistent as cherished heirlooms, and be effective for mischief now. Especially is this the case with regard to the large group of diseases of the nervous system. There is much more than the mere physical contamination by descent in the etiologic conditions of a boy or girl, who may be brought up in constant association with an idle, self-indulgent, hypochondriacal or drunken father; and it is quite impossible to over-estimate the dire misfortune to a girl of being educated by an hysterical mother. No high powers of the microscope are needed to discover the *modus operandi* of the *materies morbi* of the contagium of "bad example."

I pass now to some special examples: 1st, the redundancy; 2nd, the deficiency; as well as 3rd, the arrested development of certain organs afford scope for the teratologist rather than the physician. They furnish illustrations of curious facts in heredity, and in this way are interesting and instructive, and may be useful. Hare-lip is so often the result of a mental impression made upon the mother, that the sequence of events cannot be confined to the chapter of accidents; the same is true with regard to supernumerary fingers or toes, and these peculiarities are liable to recurrence through successive generations. Observe here that the original cause of the deformity was not hereditary but accidental, and yet that it became hereditary. This question of the hereditary transmission of acquired habits or conditions is still *sub judice*, but to my mind many of the facts recorded by Darwin are susceptible of this interpretation, notwithstanding the very strong evidence afforded to the contrary by the history of the habits of the Mahometans and Hebrews.

4. Morbid conditions of function or structure of particular organs or sets of organs, and such as do not affect the *general* health, are very commonly met with, and for some of them

much may be done. These may be resolved mainly into organic changes which limit, derange or destroy, functional activity. *(a)* The organs of special sense furnish the best examples of this class. Almost every variety of limitation or perversion of the sense of sight, from slight myopia to absolute amaurosis, seems to run in families. Sometimes the defects are congenital, sometimes they appear in adolescence, and again they may be deferred until declining years. It is in the early recognition of these maladies that the main hope of amelioration is to be found. Ophthalmic science is a growth of our own day, and its powers are now being used for the education and strengthening of the healthy eye; in the timely correction or removal of some sources of deficiency; and the supply of optical instruments to reduce to a minimum the disabilities with which some are born and which others acquire. Whatever may have been the prescience of our forefathers and their skill in surgery, it has been reserved for the latter part of this century to see "the blind receive their sight," and these not only among the favoured few but among the multitude; and still further, not as the result of any painful operation, or in the face of any risk, but simply by adding to a profound and scientific knowledge of the structure and functions of the eye the aid yielded by a mastery of the sister science of optics.

(*b*) Deaf-mutism, again, may be hereditary, congenital, or acquired, and some of the most astounding results of training have been witnessed in this field. A congenital deaf-mute, if left alone, becomes as a rule an imbecile; one who has been born with language and hearing but has lost them both in early life, may become the same, if nothing be done to educate him, while the results of due teaching are marvellous. Two boys, brothers, were brought to me at about three and five years of age; they were congenital deaf-mutes and imbeciles, and examples of the same miserable condition were found in other members of the family. A very clever, most patient and persevering tutor was found for these boys, and when the elder was between eleven and twelve years of age he had been taught to read, write, and speak with accuracy.

He could read not only from books but from the lip or from the hand; could articulate very well; could parse a sentence in English and translate it into French or German! There are thousands in this country who have no advantage of this kind, and so they remain to the end of their days mere vegetating boys and girls, or men and women, a burden to their relatives and a disgrace to the community.

5. The fifth group of hereditary diseases is one so large that it seems to include almost all the maladies that flesh is heir to,

except those that are the result of direct introduction of poison from outside. They are as numerous as the organs of the body, and as various as the possibilities of change. Such inherited ailments agree however, in their consisting of a general tendency to disturbance of varied functions and structures, and in their becoming expressed in the form of so-called diathetic or "constitutional" disease.

If there are, on the one side, occasional examples of hereditary "nervousness," or simple epilepsy; there are, on the other, tubercle, scrofula, Bright's disease, and others about which it may be truly said, "the whole head is sick, the whole heart is faint, and there is no soundness in it." Yet, even in extreme cases, preventive medicine has its work to do.

(*a*) The condition of ill health most frequently met with in hereditary diseases of the nervous system, is one of undue liability to disturbance;—given in any one of the antecedents of a particular individual, either insanity, epilepsy, hysteria, tendency to excesses, great nervousness, or what not, the outcome may be any other of the maladies mentioned, and not at all necessarily a reproduction of the initial disease. It is by bearing this fact in mind that the physician will see the necessity of being armed at all points. It is not enough to avoid or counteract the tendency to convulsions in the first dentition, the second, or the third, but other diseases such as chorea, hysteria, wilfulness, tricky ways, cruelty, and deceit must be borne in mind. No routine practice will be useful; it is often worse than useless. For example a child at twelve becomes nervous and restless, his father had fits when he was young, and is an odd man now; some other members of the family had convulsions, an uncle was epileptic, and therefore this is regarded as a case for bromine, a diet restricted to insipid inefficiency, books are to be put aside, school abandoned, the boy petted and pampered at home in the bosom of his family, several of whom are somewhat queer, and so—in spite of bromide and of a redundancy of counsel—he becomes a victim to the very malady from which so much was done with the intent to protect him; and this and the like has happened scores of times in my experience, when the boy was simply anæmic, wayward, underfed, and not quite straightforward in his ways, and really required iron, not bromine; good food and plenty of it; the discipline of school, as well as its work; the companionship and the sports of his own sex, instead of the petting of his sisters, and little brothers, over whom he tyrannised in secret, and so escaped the thrashing he deserved.

Another illustration of the like mistake is seen often in girls, whose mothers have passed through an early life of indulgent

petting into one of hystero-mania, or egomania, and gradually into that of chronic silliness and self-absorption, and then follows the sacrifice of parent, husband, child, or friend to each and all of her foolish whims. "No one has ever opposed her," "She has always had her own way;" this is what we are told, therefore she must go on as she has been doing, and her daughter must follow suit. There is nothing the matter with the girl except occasional migraine, from some real or hypocritical fasting, or from sitting up at night without food poring over a trashy novel. She can sit a horse, but she cannot sit upright in a chair; she can play lawn-tennis, but she cannot walk; she cannot sit out "morning church," but she can dance for five consecutive hours. "She is just like her mother," her relatives exclaim; "we dare not thwart her, or she will become as bad," and so she goes her own ways and fulfils their worst predictions. These are but common illustrations of the fault of thinking that hereditary disease must take its parent form; or of acting upon the presumption that, as the form is the same, there is nothing to be done. On the contrary, much may be done by taking patients from home, and all its evil ways; giving regular employment of useful sort; exercise of mind and body; fresh air, good food, plenty of rest at reasonable hours, and utterly declining to admit the existence of anything but a slight malady that needs, however, definite treatment, and that of the kind described.

(*b*) Of gout, rheumatism, tubercle, scrofula, syphilis, cancer, Bright's disease, and many others, it is only necessary to observe that to be forewarned is to be forearmed: and that, when there may be a strongly marked hereditary taint, its development into disease may often be delayed or eradicated by timely care. We lose more lives through carelessness than through ignorance. May not the thin limbed, and thin faced boy, with pink and white complexion, over tall for his age, who easily perspires and passes lithates; whose temperature and pulse run up quickly; who declares that he is very well until some general langour or local pain compel him to give in,—might he not often be saved from attacks of acute rheumatism, by careful habits, food, clothing, and medicine, and so spared all the troubles of a damaged heart? We have to look for these things, not have them thrust upon us. The day may be yet distant, but it will surely come when regulated physical examination of the bodies of the young will be as necessary and as common as examination in the Latin grammar, or the multiplication table, or other matters.

6. But there is another group of hereditary conditions, not common, but well marked, viz., a proclivity to "take diseases,"

sometimes of several sorts, sometimes of one only, for, *e.g.*, such as scarlet fever or whooping-cough. The converse condition of insusceptibility cannot be regarded as a morbid condition. Caution as to exposure is almost as important in the one case as in the other, for rashness is not without its victims, and to this allusion has been made already. Many precautions must be taken on behalf of those who have hereditary taint, for the conditions may be multiform, which come together to produce from it the fully developed disease. As an example of popular knowledge on this point I quote a paragraph from *The Times* of Sept. 12th, in its review of Mr. Colvin's recent "Life of Keats." The writer says, after alluding to the eminently pugnacious character of the poet in early life, "It was not till the hereditary taint of consumption, which had already killed his brother, became developed by the over-exertion of a walking tour in Scotland, that pecuniary troubles, caused by a stupid and stolidly unsympathetic guardian, combined with the hope deferred of a long engagement to Fanny Browne, and perhaps to some extent the disappointment of literary ambition, fostered a certain morbid tendency of his nature, if the term 'morbid' can fairly be applied to a turn of mind to which literature owes some of its greatest masterpieces."

B. Sex has always found its place among the "predisposing causes of disease"; and if general etiology were the theme of this address there is very much that ought to be said regarding it. But as the physician has no power to direct the production of boys or girls respectively, all that preventive medicine can do is to guide the development of each. Organs must be present to take on morbid action, but the *differentia* of sex are far wider than the possession on the one hand of ovaries, and on the other of testicles. The moral, mental, and physical conditions and aptitudes of the two sexes differ; and while civilisation has intensified, through generations, these *differentia*, the tendency of much recent fashion—I cannot call it civilisation—has been to diminish them: so that we encounter on every hand manly or "masculine" women and effeminate men. In uttering its protest against this perversion of nature, this devolution instead of evolution of the race, preventive medicine may be of service.

There is nothing to my mind more simply silly than the "cant" or "slang" that has been uttered about the "superior" and the "inferior" sex. Each may be perfect in its way, but each is spoiled when it apes the other. In rough conditions of life women may have been, and are now, better fitted for physical labour than are those whose very configuration and faculties have been modified by social habits of refinement; and it

certainly is not the aim of the obstetric physician, either man or woman, to encourage the development of the "masculine pelvis."

It is worthy of note, here, that it is not the highest qualities of man that young women imitate, but rather, on the one hand, the roughness of the youth, his bravado, and uncouth language; or on the other, the lackadaisical *nil admirari* tone of the pedant and the fop; with, it may be, an occasional dash into imitation of excessive learning, and the habits of the ascetic or recluse. The men who mock women's ways also mock their foibles, not their strength; and lisp and sigh or groan out their unsatisfied longings in vapid admiration of sentimental nonsense, whether it be in poetry, music, or painting, and find out something "quite too lovely" in a line, a strain, or a daub, that no sensible man would care to hear or see again.

The brain of women is not improved by being roughened or over-strained; and the emotional nature of man is enfeebled by this reversal of the order of Nature; and we find the tendencies to disease inverted without any advantage to either. The physician may, I think, do much in counteracting this tendency of the present day; protesting, on the one hand, against all foolish pruderies, mock-modesties, and the like; and, on the other, encouraging healthy habits of body and mind, always bearing in mind that the highest type to aim at is the perfection of woman and the perfection of man, and not the production of moral and mental hermaphrodites which, thank Heaven, are usually sterile.

Let it not be supposed that I do other than admire the great strides that have been made of late years, in the higher education of women, both for intellectual and practical work. These may be readily overdone as they are in men, and very frequently the results of over-strain are seen in illness, incapacity, and distress. Their exhibition, however, is less painful than the frivolous inaptitude and idleness of men, who, with all social and educational advantages, do nothing, never occupy themselves with any calling or pursuit, but are content to "bide or loaf about" and live upon their incomes, or their friends as the case may be. Over-strained women often become sour and cynical, and morbid, as do briefless barristers and unpopular parsons, who may have much laboriously gathered learning in their brains, but no congenial work to do. They complain of like discomforts, "diminished brain-power," as the favourite expression goes, and entire dissatisfaction with everything and everybody. Under-occupied men become hysterical and silly, and the prey to every form of hypocondriacal misery. It is the highest sphere of man and of woman to be the complement of

each other, and to combine in the work of home first, and then of all around it; but the work of the one should be a woman's work, and of the other, "all that may become a man." It is in the imitation of the ways of the other sex that women becomes repulsive, and man despicable.

With regard to sexual proclivities to organic diseases, there is something for the physician to do in being forearmed. For example, the greater frequency of simple ulcer of the stomach, of erythema nodosum, goitre exophthalmica, and the like in women; and of angina pectoris, cancinoma ventriuli, locomotor ataxy, and other maladies in men, may be of service not only in diagnosis and prognosis, but in treatment.

There is, however, much that prevention may do by regulating the habits of boys and girls. In healthy exercise, the avoidance of over-strain of muscles and prolonged fatigue; in wholesome food and sufficient rest; and in a score of ways many a trouble which might easily become developed into disease may be avoided. Many cases of heart and lung disease originate in the rough games of schools; many of the troubles of women in their indolent and unwholesome school-room and after life, in the follies of their dress, and the hours they keep.

C. Age. We know much, but understand little, of the time-ordered events of life. There is an average pulse and respiration time; there is the incubative period of life as well as of the exanthemata; dentition, puberty, climatic changes, and decay have their relations, more or less fixed, with time; and a knowledge of the predispositions attending various ages may be of service in the prevention of disease. In infancy the thermogenesis is low and the capacity for digestion limited to certain kinds and quantities of food; so that danger lurks in defective clothing, and defective feeding. There is rapid development, and the reflex functions are over-active, so that there is undue proclivity to spasm, not only of the voluntary muscles, but of the vessels; for spasm may cause infantile paralysis as well as infantile convulsion. Febrile conditions are common, and so are local disturbances of the circulation, such as internal congestions, and other forms of congestion not internal, such as chilblains. It is by regard to the nursery, the clothing, the food, and the surrounding conditions of domestic kind, that the physician will ward off much disease.

In dentition—whether the 1st, 2nd or 3rd—the nervous conditions which precede as well as accompany the eruption of the teeth must be duly regarded and foreseen, and so, many troubles averted before local discomfort of the gums has taken place.

At puberty it is by guiding the *general* habits of the individual, rather than by looking after possible *local* troubles; by maintaining a healthy tone of domestic life rather than by special treatment, that the physician will do his best to prevent disease. We are too often disposed to be looking for some special sign of change, forgetting that "change" is always going on; and so, sometimes, we may let golden moments or months pass by unused. The follicle of the wisdom tooth may be found in the embryo jaw; and many of the evils of all the so-called "changes of life," exist long before any special events have made them obvious. Bearing these thoughts in mind we may always see much to guide us in advising those upon whom "age" is stealing, but who have as yet had no warning that it is so, for they are "younger than their years." Those who are "older" often come quite soon enough, but rarely too soon, for help. The horizon of thought and work ought to be made smaller when memory becomes treacherous, arteries rigid, and the heart's impulse low. Timely caution, based on facts which only the doctor knows, or from the revelations made to him in his confessional—although carefully concealed at home—might save hundreds of "shocks," or more slowly growing and increasing griefs, when some unlooked-for "break-down" occurs, and relations and friends exclaim, "This is quite too terrible; he seemed so young a man, and was only yesterday quite busy at his work, and full of life and schemes." He ought *not* to have been busy at his work.

As in babyhood we are exposed to the wills and whims of others, to carelessness, stupidity, or over-fussing; to bad feeding, neglect, or exanthemata; to tumbles, broken legs, or other frivolities; so, later on, when the romantic period of youth—be it for learning or for play,—has done its best or worst, and *early middle life* begins, the exposures fraught with danger are those of over-excitement and over-work, and against these the physician knows only too well how much he could do if the patient would but hear and follow. We pass on to *middle life:* sometimes a wholesome table-land, but often a still arduous, too arduous climb, or a slow decadence of failure and dismay; and we see success leading to excess on the one hand, or failure plunging into dishonesty or despair upon the other, and here too we must again warn in time; and as the life goes on to its *second infancy*, through an emotional epoch of pitiful weakness, a senile hysteria, the physician has again to use all his care to see that he, who has outlived all those who gave him joyous welcome to his cradle, is yet tended as he should be, and piously cared for to his shroud.

There is no stage of life at which we are not wanted, no age

when we are without anything to do, and let us be ever mindful of our high responsibility of foresight, being assured that in the vast majority of instances we, in spite of many prejudices, shall find ready adjutants thankful for any hints that we may give; and, by doing our work well, be spared having to frame an answer to the terrible question sometimes, quite fairly put, "Why did you not tell me this before?"

D. Temperament is a word more frequently used than analysed; and although its striking forms are known to all, it sometimes happens that its influence on the tendency to disease is disregarded until the disease is brought about. The physician, however, should be on his guard, and try to prevent the "*sanguine*" youth or man from relying too complacently on his energy—which may not always mean strength—and so protect him from the consequences of undue hopefulness, carelessness, and from many troubles he had not in the least degree anticipated. On the other hand, the "*phlegmatic*" may have their morbid proclivities lessened or removed by timely warning, and rousing to a sense of duty; while the "*nervous*" may be strengthened against their trouble by the wise counsel of the physician, who may have the art of obtaining confidence, and speaking with authority.

II.—I come now to the *second* great group of "causes of disease," to which I alluded at the outset, viz., the disturbances of the equilibrium or balance between the necessary elements of income and expenditure, whether these be of matter or of force. It is absolutely necessary for health that we should "take in" certain things and forces, and that we should "give out" others. It is also essential that what we "take in" should be wholesome, and conducive to healthy life.

This range of subjects is so wide and varied that I can but enumerate some of them, and point out, generally, wherein the physician can act in the prevention of disease.

A. Income is both material and immaterial, or ponderable and imponderable; we need food and air, light and heat on the one hand; excretion of material, and exertion of nerve and muscle on the other. These should be balanced, or we are not in health.

1. The *income* of matter involves all that is included under the head of "Food,"—solid, liquid, and gaseous,—which may be either defective or excessive in quantity, or wrong in quality. The absence of certain elements, such as vegetables, for example, has its entail of scurvy; while deficiencies of either the albuminous, amylaceous, oleaginous, or saline elements produce their

specific morbid changes. Deficiency of food of all kinds is often, too often, sadly, the cause of multiform maladies; associated, as it almost invariably is, with other anti-hygienic conditions, such as over-work, over-crowding, and intemperance. Excessive feeding, on the other hand, which at last brings its own remedy in loss of appetite, may on the way to that stage, produce a hundred maladies of every organ in the body.

But the great source of disease, against which preventive medicine has shown its strongest powers, and with which it now wages war the most vigorously and incessantly, is the introduction of noxious matter, either with food, by the air we breathe, or by direct inoculation.

The appliances of science have done much to diminish the evils that arise from the metallic or other poisons, such as lead, mercury, antimony, steel, phosphorus, and the like; and the mode in which good has been obtained is by the prevention of their entry into the organism, and also by rendering assistance in their excretion. In like manner those more subtle poisons, which are the physical bases of all zymotic disease, are to be robbed of their power for mischief mainly by being kept out of the body. The physician has found out the sources of many of these poisons, as well as the modes by which they enter the body, and having done so has devised means for their arrest. The *materies morbi* has been separated from much that had surrounded it, and measures for its modification or destruction have been discovered and applied. Our knowledge of the definite importation of cholera, typhoid, and more recently of some outbreaks of scarlet fever, by means of water and of milk, and further, the knowledge that by simply boiling these fluids the poisonous material is deprived of its power for mischief, afford grounds for hope that, by increased observation, the sources of other maladies may be found, and means for their destruction be devised.

The magnificent results that have been obtained and demonstrated with regard to vaccination and variola have stimulated the zeal of many enthusiastic workers, and raised—as almost all beneficial discoveries have done before—a perfect tempest of opposition, misrepresentation, and frivolous and irrelevant talk. The questions of syphilisation and of inoculation for rabies must be regarded as still *sub judice;* but a sufficiently strong case has been made out in regard of both these poisons, not only to justify, but to demand further enquiry.

2. There are certain imponderables, such as heat, light and electricity, that we require for healthy life, and the deficiency in the income of which is the frequent cause of disease.

(*a*) We all need external warmth, and at the extremes of age the need is greatest. Many follies of habit may be rectified by the physician, even although in some individuals the constitution is so marvellously elastic that it can bear an amount of illusage that would kill many a race of animals. Whatever may be said of the process of "hardening" by exposure, it surely cannot be a universal advantage to undress under the trees of Hyde Park, in an east wind and drizzle, at 7 a.m. in the winter months, plunge into the half-frozen Serpentine, and get home to breakfast cold and blue, with chattering teeth, and exclaim with a mixture of pharisaism and apology in tone, "It is when it is cold as this that it does you all the good in the world!" There is much "tubbing" and bathing in the present day that is excessive, unphysiological, and mischievous, and there are endless follies in the form of clothing that the physician can do little to cope with simply because there are two much more popular preachers than he, viz., fashion and fad.

Excessive heat has some injurious effects in itself, but the really active sources of heat-disease in hot climates are the malarial or other poisons which are there, and the injudicious clothing, eating, and drinking which in too many places are habitual. The occupations which expose stokers, furnace-men, and the like to intense heat may be rendered nearly if not quite innocuous by attention to clothing, to the length of exposure, to the full supply of water and of fresh air, and to the alternation of work done with periods of due freedom from exposure; these things to be arranged with knowledge of the wants entailed by special kinds of labour in individual cases. To the philanthrophy of employers, and the zeal for all sorts of social improvements in a rapidly growing class of men, as well as to the labours of the men of science, are we indebted for the prevention of much of the evil that excessive heat might bring about.

(*b*) The absence or deficiency of light, and especially of sunlight, shows its morbid effects in the impaired health of miners, navigators, workmen in cellars, in city offices, and in the night. The night-working to which I refer is such as must limit the income of sunlight to a considerable degree. Those who suffer most are the reporters, literateurs, printers, writers, and many others whose work is nocturnal exclusively, and who require some distinct changes to be made in their habits.

Anæmia is the prominent mischief brought about by deprivation of light, and anæmia means very much—very much more than mere pallor of the skin. There is no organ in the body which it does not affect; it cannot be uprooted by iron or food, or fresh air, or any other means save that of light; and we do

well in prescribing this early in the anæmia of night-working men.

The exposure to excess of light may be mischievous to the eye in many ways, but the prevention of such trouble is obvious, viz., the avoidance of such exposure. But the great majority of cases of "insolation," are to be traced to the co-operation with exposure to light, of excessive heat, bad air in tents, and barracks, unfit clothing, and irregularity of habits, together with over-exertion, and early neglect of symptoms.

(*c*) Electrical disturbances of health, such as occur in electric and magnetic storms afford much interesting matter for examination, but they are of comparatively rare occurrence, and are often susceptible of explanation by mental and moral rather than physical conditions.

(*d*) There is, however, another very common source of discomfort and disease increasing year by year in this restless age: I mean that of physical concussion of the body as a whole, or of its parts. "Accidents" show us what violent concussion may effect in one moment; but daily life points out a more serious danger than accident can do. A great amount of shaking and knocking about may be borne by some with impunity, but there are hundreds, nay, even thousands, who are now steadily, slowly but surely damaging themselves by constant travelling, and especially by railway. Such travelling is often accompanied by hard work, much worry, and exposure to the changes of temperature, which make up what we are pleased to consider as, and call, "our climate." But beside and above all these the mere recurrence of shaking or "shock" is observable enough. The most prominent effects are irritability of temper, restless fatigue, want of power of application, defective memory, want of confidence, and want of judgment, with insomnia or uneasy sleep, and depression of spirits. The jar of frequently stopping suburban trains is more commonly and quite as seriously damaging as are the occupations which lead men to travel many hundreds of miles per week. Crying children, who will not be rested by a gentle rhythmic movement, may be shaken to something like sleep by a vigorous nurse; and so may the busy man who, paper in hand, jumps into a first-class carriage at the end of a day of work and worry, and is concussed into a sort of coma by six to seven minutes of the train. In the early stages of such troubles, some modification of the daily mode of transit may be of service; but when the discomforts have gone to the point of destroying sleep, appetite, and relish for work, nothing but an absolute cessation of the travelling is of the smallest service.

B. The next great group of causes of disease may be put under the one head of modified expenditure as compared with income. There must be in health an outgoing of both material and of energy; and disease is actually present, lurking near, or very easily brought in when arrest of excretion is present.

1. The excretion of *material* is as essential as its introduction. (*a*) Arrest of "excretion" introduces "local" troubles, which tell back and limit "secretion," and this latter limitation becomes at once a "general" or "constitutional" disease. Retained cutaneous excreta produce acne and miliaria; arrested secretion may be followed by pleurodynia, sciatica, local paralysis, pleuritis, or any other inflammation. So with the urinary organs. Arrest of excretion affects the bladder, and the kidneys by a backward action, but the non-action of the kidneys places life in imminent peril from toxæmia of most urgent sort. So with the bowels,—habit, laziness, shyness, or what not, may lead to hernia, or apoplexy, by the straining they induce; but more frequently hemorrhoids, accumulations of fæcal matter, and their consequences, are the immediate result; but if the intestinal *secretion* be either arrested or misdirected then grave constitutional disturbance is present or at hand. The same principles hold good with regard to all the systems of the body. The physician has to guide with regard to "excretion"; but common sense, about matters that are mere "pathological pap" to himself, he will find absolutely wanting, and its dictates quite unappreciable by otherwise well-informed and capable men and women, as well as by boys and girls. Want of attention to "excretion" may be long concealed, but a suppressed "secretion" at once places the patient in the doctor's hands. General medicine may do much for both, but its true rôle is in prevention.

But (*b*) evacuations may be excessive, and these of either blood itself, or of other fluids containing it, or its main elements in large proportion. It is enough to mention the drain of hæmorrhoids, or of menorrhagia, the exhaustion of chronic diarrhœa, diuresis, or diaphoresis, and leucorrhœa to indicate the directions in which preventive medicine may do its best; only again emphasising the common fact that these things have often to be looked for to be discovered, and then some considerable discount allowed as to the accuracy of statements made from either delicacy, the wish to be let alone, ignorance, or the "little knowledge" carried to the point of "danger," conceit, caprice, or stupidity.

2. In controlling the amount, quality, and conditions of

"expenditure," in *mental*, *moral*, and *physical* directions, the physician has a wide range of work. The elimination of force is as important as is that of matter.

There is, on many sides—mental, moral, and physical—a tendency to meet excesses of one kind with excesses of another. There is a "polarity," so to speak, in society, to be seen in the way and degree to which overwork goes along with—I cannot say begets—underwork; mental strain is associated with mental idleness; eager attempts to solve moral and social questions by something more rapid than a motto of mere "solvitur ambulando" impotence, side by side with the lazy "nil admirari," provoking egotism and uselessness of full-blown or unripe swelldom; while at the same time the training of the physical athlete is seen in heightened contrast by glancing at the waxy, cumbrous, dull stupidity of those who take no bodily exercise beyond that of lounging in the carriage or the club, diversified only by the too-frequent cigarette.

(*a*) Defective mental occupation begets—by way of bad hours, alcoholism, a love for poor literature, and self-indulgent habits—silliness, self-consideration, egoism, hysteria, hypochondriasis, and progressive feebleness of mind, memory, and understanding. Ten talents may earn another ten; or, *per contra*, they may be abused or lost, with character to boot, by simply being laid aside or hid in a napkin; for it is not the man with *one* talent only that may call upon himself the strong disapprobation of his Lord. To use the powers we have, and incite others to do the same, is a part of our work in the prevention of disease.

Again, the moral nature of man and of society may be stunted, misapplied, or blotted out by simple indolence. How often do we not meet with people who care nothing for anything or anybody but themselves; who read both sides of a debate, a philosophical dispute, or a police report, with a languid indifference, and without ever caring to exercise their own thought as to which is right or wrong, "because its such a bore to make it out, don't you know,"—until, by steady practice of not using the brains he has, his one little talent has shrivelled up, and when he may, perchance try, to turn it to some account, he finds that somebody or some conditions have put a brass farthing in its place. This don't-careism of young people so common now may be somewhat improved by parents and tutors, but it is the physician who will do more than either if he uses his opportunities aright.

The mere allusion that I have made to the deficiency of "physical" exertion, is enough to point out the true line that preventive medicine has to take. It is not so much in youth

as in middle life that its effects are shown, and our powers are often limited to the diminution of troubles as they occur, rather than to their prevention beforehand.

(*b*) In this part of "the Nineteenth Century" we come into contact with excess of work,—mental, moral and physical—on almost every hand. But let us, so far as consequences to health are concerned,—at once distinguish between work with worry and work without; which comes almost to mean voluntary and involuntary exertion. Work does not hurt much, worry does. Some are put to learn or do things that they are unfit for, and they suffer. The work may be of the kind that they cannot do, or the amount required may be out of proportion to their strength. Some men can no more learn mathematics than others can music. There is a *Pons Asinorum* somewhere, not only in Euclid, for almost everyone, and much trouble of school, and college, and after-life might be entirely spared if relatives and tutors would recognize the fact.

Mental work is not excessive if the appetite be good and the sleep sound; if these be interfered with, the student or the athlete (in muscle) is doing too much. Work for its own sake is beneficial, but under the pressure of an examination looming in the distance, or of some panic in business, work, to get over the difficulty, is often made excessive, and then worry comes on, with its train of physical troubles that attend loss of appetite and loss of rest. The functions of all organs are damaged, and well is it for the man who has the physician for his friend to help him how to arrange his life.

The effects of sudden moral shock are known almost as well as those of physical concussion; but the long continued wear and tear of a life, distracted by a conflict of emotions, is often unsuspected or unrecognised until it is too late.

Hysteria, melancholia, paralysis agitans, a confusion of ideas and purposes when any attempt is made to use them—what I have called a mental and moral chorea—through incapacity of mind, and loss of all decision and precision of thought are the most common events; but, with this, there often comes as well, some strange moral perversion, taking the form of extreme melancholia and self-accusation most frequently, but occasionally running into another, still more lamentable state, viz., that of general paralysis of the insane.

The only excess of physical exertion to which I will allude now is that of such kind as shall embarrass the heart and nervous system. There are no physical exertions which, in themselves are necessarily detrimental to the heart. Rowing, riding, walking, running, climbing, in reasonable moderation or only occasional excess are beneficial, and highly so; but when the amount of

necessary exertion is compressed into a deficient amount of time then it becomes mischievous. The heart has its own special relationships to time, and if these are seriously or persistently disturbed both functions and structure suffer. An exertion which quickens the pulse and respiration may be harmless if within certain bounds; but if the eyes become prominent, the face flushed, the lips livid, and the extremities cold and dusky, the danger point is reached. The line is an easy one to draw but a difficult one to keep. Yet I am sure it is not out of our power to help. Many cases of heart-strain may be greatly relieved by rest, and it is by violent rather than continued over-exertion that the brain becomes gravely affected. But too prolonged or too extreme an amount of physical exercise has its victims, suffering from weakened arms and legs, and other evidences of spinal exhaustion.

The fatigue of excessive muscular exertion upon the nervous system is seen in loss of sleep and appetite in a small scale; but its effects upon armies on the march has been seen in an increased frequency and severity of traumatic tetanus and other affections, partly induced by worry, defective food and clothing, and often by accompanying depression. Epilepsy, chorea, paralysis, and the like I have often found to date from physical fatigue, and to have their recurrences almost invariably traceable to the same cause occasionally brought into play.

That which we denote "preventive medicine" when applied to individuals, becomes general "sanitary science" when we have to deal with masses; and it is only by a careful scrutiny of all the *causes* of disease that we can render that science as efficient as it ought to be. It has sometimes happened that researches in one direction, and for the attainment of one end, have been unexpectedly the means of throwing much valuable light upon cognate or outlying matters, such, for example, as the relation, almost accidentally discovered, between the drying of the soil in sundry towns and the diminution of phthisis; but in the main it has been by earnest, planned, and persistent industry that the great achievements of science have been possible.

Life is lengthened, its existence rendered less painful and more hopeful, and its ailments so much reduced by what has been already accomplished, that—given what is wanted in time and in freedom of research—there seem to be scarcely any limits to the good that we may predict for future generations. Diseases, our enemies, one after another may be diminished, rendered harmless, or stamped out of existence. The adaptation of

man to his environment may be so greatly improved, his frame so fitted to resist not only disease but natural decay, that its pains and weakness may disappear, and be remembered only in the history of evolution, and thus its inevitable end may be without either suffering or fear. The moral nature may be so attuned to its highest faith, and so free from fret, sorrow, or remorse, that death will be welcomed as was birth, for the last "enemy" that shall be destroyed is death; destroyed, *i.e.*, by being no longer our enemy but our friend.

On "Notes on the Sanitary Improvements of Bolton during the ten years ending 1886, *with the more important statistics for this period as compared with the preceding decade," by* EDWARD SERGEANT, L.R.C.P.Lond., Medical Officer of Health, Bolton.

IT will be my endeavour to give as concisely as possible the history of some of our sanitary undertakings, with the experience gained thereby. In common with many sanitary authorities, we have had occasion to consider from time to time important questions appertaining to health, including hospital accommodation, notification of infectious diseases, disinfection, refuse disposal, &c., when these matters were comparatively new, and the public had to undergo a period of education before they would accept them. Fortunately a fresh era has commenced, and there is no longer any need to grope in the dark, for the public have light and are alive to the necessity of the above-mentioned requirements, and it will not be long before they are generally adopted. The statistics appended are eminently striking, and do not require any detailed analysis on my part.

Table I. shews the annual mortality with the principal zymotic deaths, &c., during the ten years 1877–86.

Year.	Estimated population.	Total deaths.	Rate of mortality.	Deaths of children under 1 year.	Deaths of children between 1 & 5 yrs.	Percentage of deaths under 5 yrs. to total deaths.	Deaths from							Percentage of deaths from principal zymotic causes to total deaths.
							Small-pox.	Measles.	Scarlet fever.	Diphtheria.	Whooping cough.	Fever.	Diarrhœa, including English cholera.	
1877	95,500	2226	23·5	610	461	48·0	...	53	106	3	100	49	106	18·7
1878	105,000	2313	22·0	717	466	51·1	...	42	144	2	61	39	206	21·5
1879	105,000	2233	21·0	616	341	42·8	...	14	45	3	97	42	62	11·8
1880*	106,700	2835	20·5	832	645	52·0	1	216	112	1	89	27	245	24·4
1881	105,414	2022	19·1	575	306	43·5	...	1	31	2	119	25	91	13·3
1882	106,767	2277	21·3	650	479	49·5	12	146	21	9	72	29	152	19·3
1883	107,862	2157	19·9	633	283	42·4	...	2	6	4	35	25	152	10·3
1884	108,968	2615	24·0	717	503	46·6	...	111	15	2	106	33	211	18·2
1885	110,085	2282	20·7	612	307	40·2	1	38	9	5	58	18	83	9·2
1886	111,214	2572	23·1	697	472	45·4	...	137	16	7	75	18	156	15·9
Average for 10 years..		2353	21·5	666	426	46·1	1·4	76	50	3·8	81	30	146	16·2

* Fifteen months.

Table II. gives the mortality extending over the ten years 1867–76.

Year.	Estimated population.	Total deaths.	Rate of mortality.	Deaths of children under 1 year.	Deaths of children between 1 & 5 yrs.	Percentage of deaths under 5 yrs. to total deaths.	Deaths from Small-pox.	Measles.	Scarlet fever.	Diphtheria.	Whooping cough.	Fever.	Diarrhœa, including English cholera.	Percentage of deaths from principal zymotic causes to total deaths.
1867	77,468	2218	29·0	607	525	51·0	...	3	239	...	94	61	129	24·9
1868	78,704	1956	25·0	649	389	53·0	...	113	28	7	10	52	201	21·6
1869	79,960	2100	26·7	693	374	50·8	22	54	35	...	60	69	100	16·4
1870	81,400	2233	27·3	752	478	55·0	6	45	79	5	17	52	227	19·3
1871	82,854	2166	26·1	660	412	49·4	29	...	172	3	8	30	205	20·6
1872	87,354	2432	28·0	720	536	51·6	49	124	96	2	53	66	180	23·5
1873	90,000	2097	23·3	646	404	50·1	7	4	136	3	100	43	143	20·8
1874	91,651	2219	24·3	629	432	47·0	3	41	176	1	16	39	145	19·1
1875	92,800	2403	26·0	685	463	47·7	3	114	38	3	121	45	162	20·3
1876	94,300	2199	23·6	628	341	44·0	6	26	41	1	44	84	137	15·5
Average for 10 years..		2202	25·9	667	435	50·0	12	52	104	2	52	54	163	20·2

You will observe that the general mortality during the past ten years has been considerably reduced. The average death-rate being 21·5 per 1000, as against 25·9 per 1000 for the preceding decade. The lessened mortality is represented by an annual saving to the community of over 400 lives, and the amount of sickness prevented must have been enormous.

The infant mortality, which may be taken as a "health barometer" of a town, has also decreased. The general death-rate from zymotic diseases has been sensibly lowered, and the reduction has been most marked in the notified diseases—small-pox, scarlet fever, and fever including typhus and typhoid. It is likely that the greater attention paid to the storage and frequent removal of refuse, and the general sanitary improvements, may have beneficially influenced the diarrhœa death-rate. Measles and whooping cough have not been dealt with as diseases that could be influenced further than by isolation at home—which however is almost impossible in the artizan homes—advice and disinfection: hence we find that these diseases show no diminution but rather an upward tendency during the past ten years. No doubt, as the ramparts against infection are extended, measles and whooping cough will have to be included in the list of notified diseases, and hospital accommodation will be required for their isolation, but at the present time we are not quite prepared for the additional responsibility.

In 1877 Bolton had the credit of being the first town in the country to obtain from Parliament complete powers for the

compulsory notification of infectious diseases. The duty of reporting is "dual," or imposed on the medical attendant as well as the householder, a system which at the present time is much favoured by sanitary authorities, and it has also the approval of the Local Government Board. Although on this point there is much diversity of opinion, experience shows that information of disease received from the medical practitioner is more prompt and reliable than when coming from the householder, so that whatever method of notification is adopted the responsibility will in the end rest with the medical man. The advantages of notification are now generally acknowledged: in the case of small-pox the disease can be kept in almost perfect check, scarlet fever may be restrained, and there is less danger of the disease being spread broadcast by children attending school in the "peeling stage." In typhoid fever and diphtheria early notification of the existence of diseases is of equal importance, and owing to the knowledge gained we are often enabled to rectify defective drainage, or take means to prevent the dangers which would arise from polluted water or contaminated milk, isolation of these diseases in the hospital being not always practicable. The total diseases notified since our compulsory clause came into force, amount to 7217, made up as follows: small-pox, 323; scarlet fever, 4106; diphtheria, 110; fever, 1151; puerpural fever, 35; and English cholera, 13. During the three years ending 1880, measles was on the list of diseases to be notified, and information was received concerning 1453 cases.

Without a hospital for the isolation of infectious diseases, the benefits derivable from notification would be limited, and on that account the provision of means for the seclusion of the infected sick ought invariably to precede notification. The extent of the hospital accommodation is influenced by notification, for when the latter is carried out efficiently, a small hospital is sufficient for the isolation of the infectious disease which may from time to time occur, but if on the other hand, these first cases owing to their existence being unknown are not secluded, an epidemic is probably the result, and the largest hospital may be inadequate to meet its demands. The Borough fever hospital was built in 1883, but it was not until January 1884 that we had occasion to send in any patients. The hospital has had a continuous use and secured a good reputation which is of much value, as it practically enables us to effect a removal without difficulty in any case we consider desirable. The following cases have been annually treated, 62 in 1884, 120 in 1885, 208 in 1886, and to the end of August this year, 177 cases have already been admitted. The proportion of patients

admitted to diseases notified show an increasing ratio, last year it was 51 per cent. as against 46 per cent. for 1885. The table below gives particulars of the total cases admitted.

Age—Years.	All Causes.		Scarlet Fever.		Typhoid Fever.		Small-pox.		Diphtheria.	
	Patients admitted.	Deaths.	Patients admitted.	Deaths.	Patients admitted	Deaths.	Patients admitted.	Deaths.	Patients admitted.	Deaths.
Under 3	35	2	34	2	...	...	1	...	...	...
Between 3 & 4	33	1	30	1	3	...	...	...	...	...
„ 4 „ 6	110	3	106	1	2	1	1	...	1	1
„ 6 „ 10	207	3	200	2	7	1	...	...	...	...
„ 10 „ 20	143	5	108	...	29	5	6	...	...	...
„ 20 „ 40	34	4	12	1	10	3	12	...	...	...
40 and upwards.	5	1	...	...	3	1	2	...	...	...
Total ...	567	19	490	7	54	11	22	...	1	1

The death-rate of patients treated has been very favourable, and it is fair to assume that cleanliness, good air, careful feeding, and efficient nursing have beneficially influenced the course of many cases, especially those removed from the houses of the filthy and improvident. The patient is also benefitted by exchanging gloomy, and perhaps unsanitary surroundings, for attentive treatment in a spacious ward, pleasantly situated and provided with all the accessories to make the necessary detention as cheerful as possible. Scarlet fever patients are generally sent into the hospital after the rash and sore throat have decided the diagnosis, and the average duration of treatment in the hospital—and, in my opinion, continuance of "infectiousness"—was, in 1885 and 1886, forty-one days for each year.

The average stay of the typhoid patients treated in the hospital was also forty-one days, and of small-pox thirty days. The total cost of maintenance per patient for last year was only 14s. weekly during the average duration of treatment. By Sec. 132, Public Health Act, a local authority may recover cost of maintenance of patients in hospital, but this power has never been exercised in Bolton, and all residents in the borough, who are not paupers, have an equal right to be admitted. We believe that while good nursing and hospital treatment may prove an advantage to the patient and his friends, the community is equally benefitted in effecting the complete isolation in hospital of infection so that it may cease to be a source of public danger. Hence we avoid the delay and unpopularity which would undoubtedly arise if payment were insisted on in any of the cases admitted.

I may briefly explain that our hospital has already cost over £9000, it is built on the pavilion principle and provides accommodation for the treatment of thirty-two adults, with 2000 cubic feet of air space per patient, and for eight children in cots. The building consists of two one-storied pavilions, an administrative block, and a mortuary and laundry block. The two pavilions are exactly the same in construction, and are placed 60 feet apart with a due north and south aspect, an open verandah runs along the south front of each pavilion, and from the centre of each verandah, and opposite the pavilion entrance, an open covered passage, semi-circular in form, leads to the administrative block, which is a two-storied building. The various buildings are supplied with the usual accommodation required for the purposes of nursing, and great attention has been paid to ventilation by means of warmed air, and to the removal of vitiated air and the offensive products of gas combustion.

The sewage is treated on the premises by precipitation and filtration, and the excreta, contents of beds, and other objectionable matter, are burnt daily in a specially constructed furnace, called an Incinerator, which is found to be of the greatest value. The hospital stands in about three and a half acres of beautifully laid out grounds, and this year a site for a new pavilion has been prepared, and the administrative block enlarged so as to be in readiness for an extension which the increasing popularity of the hospital will soon render absolutely necessary. For disinfection at the hospital we rely chiefly on washing after thorough soaking in a solution of carbolic acid. A small hot air disinfector is in use for articles that cannot without damage be washed in boiling water.

The town disinfection is conducted at a disinfecting establishment at School Hill, which is also provided with a wash-house, mortuary, and furnace for the destruction of articles very filthy or not worth disinfecting. For over nine years the disinfection was conducted in two hot-air chambers, but the process was never considered reliable, for we found that the temperature in different parts of the chambers varied considerably, and after the application of a scorching heat, say 250°, to certain bulky articles, as beds, mattresses, &c., for four or five hours, the temperature registered in the interior of the article was seldom higher than 150° to 180° F. With the new process, which has been in operation about twelve months, namely, superheated steam under pressure, the process of disinfection is more expeditious, for the steam is evenly distributed in the chamber and rapidly permeates the most bulky articles, and it is interesting to know, from the researches of Klein and Koch,

"that the complete penetration of an object by steam heat for more than five minutes is sufficient for its thorough disinfection." Our steam apparatus is the one patented by Washington Lyon, and so far it has done its work admirably.

The next subject I desire to bring before you, namely, excrement removal, I approach with some trepidation, as it is surrounded with practical difficulties of no ordinary kind. The question was considered in Bolton so far back as 1874, and it was then decided to adopt the Manchester pail system, and this has been followed with some modifications to the present time. We have now in use 6,000 dry ash closets, 8,670 old ashpits, and 1,400 water-closets. Many of the large and offensive ashpits have been converted to the new system, and the effect has been to raise the tone of health of the improved district and lower the deaths from diarrhœa. Water-carriage under favourable circumstances seems to my mind the most complete, most decent, and best adapted for large populations, but many towns from deficiency of water-supply, or owing to the condition of the sewers or outfall, are not suitable for water-carriage. In such cases some form of pail system should be adopted which will allow the refuse to be frequently removed.

The old privy, or midden, which provides for the storage—perhaps for months—of fæcal matter, together with all kinds of animal and vegetable refuse within a few feet of the very atmosphere we breathe, is abominable, and ought to be prohibited by law. According to Dr. Buchanan, in all towns where the refuse matters are not removed frequently there is a higher death-rate, especially among children, than where the refuse matters are speedily removed. I do not propose to consider the details of the various forms of pail closets; to my mind the principle involving prompt removal of refuse is good, and the special system adopted is of minor importance. The following classification includes most of the systems in use:

1. Pails without absorbents.
2. Pails with absorbents as ash, earth, &c.
3. Pails with appliances to drain off the liquid portion.

When pails are adopted, the mechanical appliances of the closet should be as simple as possible, and the local authority should be provided with vans, suitable air-tight lids for the pails, and use the greatest care to transport the excreta to the depôt without smell. The cost of collection is increased somewhat, but then the important bearing of such removal on health, as against storage of foul matters in ashpits, should influence largely the consideration of the question. In this town, it has been calculated that the annual cost of scavenging

per house on the new system is 5s. 3d., as compared with 3s. 7d. per house on the old system. The increased cost of scavenging is no doubt large, and one can understand how easy it is for our complicated form of ash-closet to get out of order, especially in the poorer districts of the town; but then, are we justified in reverting to a modified ashpit? or in simplifying the present pail-closet? To my judgment the latter plan seems to commend itself. The bulk of the refuse of the town is taken to an admirably arranged depôt, erected at a cost of £30,000, called Wellington Yard.

The excretal refuse is there ground up with fine ash and formed into a crude manure which is sought after by the farmers, and may be stored in large quantities without producing a smell. The other refuse consisting of cinders, vegetable and house refuse of all kinds, is consumed in what is called Fryer's Destructor, and reduced to about a third its bulk. The outburn from the furnace consisting of clinker is ground up with lime and forms mortar. The amount of refuse consumed daily in this way is about sixty tons, and the mortar produced shows a handsome profit to the department of nearly £1,000 a year.

The time at my disposal will not allow me to do more than refer to the other sanitary works of the town. The new sewage works at Hacken many of you visited yesterday, and had the advantage of a detailed description from the engineer. The arrangement of detritus tanks, settling and mud tanks with the turbine and pump driven by effluent water, seem beautifully adapted both theoretically and practically for efficiently dealing with the sewage of the town and district. The clarifying agent now in use is milk of lime with ground cinders which have passed through the fire of the Destructor, and this is mixed with the sewage at the old works at Burnden, but the apparatus is equally well adapted for the employment of any other precipitating or purifying agent as carbon, alumina, &c. The total cost of the works was a little over £30,000.

The waterworks will be visited on Saturday next and during your stay in Bolton you will have the opportunity of noticing that the water is soft, clear, and of good quality for drinking purposes. The total gathering ground is 3,166 acres and the storage capacity of our reservoir is about 1,000,000,000 gallons. The average daily consumption of water in the town and surrounding district is 5,600,000 gallons, representing a supply of nearly 22 gallons per head daily, for domestic purposes, and 6 gallons per head for trade purposes. The filtering tanks, four in number—three being in use at one time, have a superficial area of 10,000 square yards, and are capable of filtering

$5\frac{1}{2}$ million gallons during the 24 hours. The works commenced operation in 1885, and since then the water has been much clearer, and generally improved in quality. The recent drought found us in a better position than most towns, but it also showed the desirability of finding additional storage for the large quantity of water which annually runs to waste.

In conclusion I may mention that during the past ten years much work has been done in the direction of demolishing houses unfit for habitation, opening out close and badly ventilated courts, and improving insanitary dwellings. To effect these improvements we put in force our local acts, which allow of compensation being given, and are more readily worked and considerably less expensive than the Artisans and Labourers Dwellings Act, 1868, or Mr. Cross's Act. The Corporation have not cared to provide house accommodation for the persons displaced, preferring to allow private individuals to undertake the responsibility. No difficulty has arisen on this score, and as an example of private philanthrophy the efforts of the late Dr. Chadwick to provide good living accommodation for the working class will long be gratefully remembered.

The system for intercepting the whole of the sewage of the borough has only just been completed at great expense, but much remains to be done for securing ventilation of the older sewers. The bed of the foul stream which passes through the town has been paved to facilitate the flow. Back streets paved with setts and six yards in width have been insisted on, and in many ways our motto has been "onward." Much work yet remains to be done, and it is hoped that the benefit to health of the sanitary improvement of the past few years will prove an incentive to continued progress.

Mr. S. W. North (York), said he did not quite know on what part of the paper they had just heard he could offer any particular observations, except on the question raised in the paper of the notification of infectious diseases. It was not unknown to some of his friends in that room, that some years ago when President of the Yorkshire Association of Medical Officers of Health, he had taken occasion to point out the objections which might be reasonably raised to the notification of infectious diseases by the medical profession. At that time he was merely induced to direct attention to the objections to the way in which notification was proposed as an all but certain method of stamping out these diseases. He had however, since then to some extent modified his opinions, and was disposed to accept

notification as a valuable aid, though he still denied that by its means we should be able to stamp out infectious diseases. In 1884 the Corporation of York had a bill before Parliament for extending the boundaries of the City. At the suggestion of the Committee of the House of Commons, the clauses known under the name of the President were introduced into the bill. One of these clauses enjoined under a penalty the notification to the Sanitary Authority of certain infectious diseases, typhoid fever, scarlet fever, &c., both by the medical man in attendance and the householder, direct notification in fact. Whatever opinion he might have held on the question of notification, the power being given, he felt it his duty to see that the law was fully enforced in the City he represented. He believed that since the adoption of compulsory notification by the Corporation of York, all cases of infectious disease named in the schedule to the act had been reported. He had in his official capacity been brought into contact with all the medical men in that city, and he had never yet known the notification to create the slightest hitch. The forms on which the terms were notified, were sent to him under cover, and he had found they came to him with great celerity and accuracy. As a consequence of careful enquiry spread over the cases of a large amount of disease, he was bound to say that the notification not only reflected the highest credit on the zeal with which the profession gave the notification, but on the care with which they gave it. There had not as yet been a single instance brought to his knowledge in which information as to an infectious disease had been given which was not true. In fact he was bound to say that from the day on which it had been introduced up to the present time the system of notification had worked smoothly, harmoniously, and absolutely honestly. Notwithstanding his opinion expressed and entertained on the question some years ago, he felt determined that when once the clauses were introduced into the City of York, they should at all events have the full benefit of their operation, and with that view he took the following course immediately after their adoption. He framed a code of regulations and instructions for the managers of elementary public schools with regard to these infectious diseases, warning them in various ways what was best to be done. Besides these regulations, he prepared a series of forms and notices, one of which was a form of enquiry, which on the report of an infectious case was immediately sent to the inspector of nuisances. After he received the notice which stated the residence, the number of the family, the number under fourteen years of age, the occupation of the parents, and general observations as to the sanitary condition of the premises, the inspector of nuisances gave a notice in which the parents were forbidden to send their children to any public elementary school from the house in which the infectious disease existed, and at the same time a notice was sent to the master of the school usually attended by the children, and he was instructed not to receive any of the children into his school from that house for a certain specified time. Similarly a note was given to the clerk of the School Attendance Committee, so that the whole of the authorities

concerned were at once made acquainted with the existence of this case of infectious disease. It was only the other day he received from the clerk a letter in which that gentleman expressed the belief that the instructions had been carried out faithfully and most loyally. He had not had to complain in any single instance of the managers of schools. They had done everything they could to act in accordance with the instructions. As to what the result would be as time went on, he could not say. They had had a mild epidemic of scarlet fever in the city spreading over two years. He himself had a strong impression that it had been very considerably diminished by this notification, and by the care they had as a consequence been enabled to exercise in keeping children away from school. It might be only a matter of opinion as to what results would follow from notification, but there was this fact, that it was bound to be of the highest value in affording statistical information of the prevalence of disease, without which it would be impossible to know how to meet it. Last year they had in York a serious outbreak of typhoid fever, which rose with great rapidity. In consequence of having prompt notification, he was enabled without doubt to trace the outbreak (over 100 cases) to the use of milk brought from a farm having three cases of typhoid fever on the premises. With the notification it became so clear that the disease followed the track of the milk-seller, that there could be no doubt as to the cause: the sale was stopped, and the disease at once declined. They in York still lacked what he thought was the natural complement of notification: a free fever hospital. They had a hospital somewhat in the form suggested by Dr. Sergeant, but at present the authorities did not see their way to make it free. They had a charge for admission, which he feared was practically prohibitive so far as poor people were concerned. He hoped before long to see it free. In conclusion, he was bound to say with regard to notification that it worked extremely well. He thought it was too much as yet to say that notification would enable them to stamp out disease. However, he was of opinion that the system had done much good, and he also thought that the system had greatly lessened their difficulties in dealing with infectious disease, and it was teaching an important moral lesson by showing the people that they ought to do their duty to others as they would be done by, and not be indifferent as to the spread of disease.

Professor W. H. Corfield (London) said he should much like to bear testimony to the excellence of the paper they had just heard read by Dr. Sergeant. He also wished to congratulate Dr. Sergeant upon the satisfactory results that had attended his administration of the public health of Bolton. The Doctor gave them statistics for the ten years from 1867–76, and for the ten years from 1877–86. He saw from these that whereas the general death-rate for the first period was 25·9, and for the second 21·5, the zymotic death-rate had been reduced from 16·2 to 11·2, a still more significant fact. These reductions in the death-rates they would all agree were of a most important character. With regard to the question of the

notification of infectious diseases, as many of them would remember the Council of the Sanitary Institute determined some years ago to find out what were the real facts about the matter. They accordingly sent out a circular to medical officers of towns where this notification was practised; they had answers from the greater number (about 20) and at the request of the Council he summarised the results, and read a paper on the subject before the Sanitary Institute. The paper would be found in the transactions of the Institute, and it showed that wherever notification had been practised it had been productive of a considerable amount of good, and that the opposition to it was more of a sentimental character than anything else, and was hardly worthy to be regarded as of practical importance. Thus they would see he was of opinion that great advantages might be expected to flow from the medical man reporting direct to the sanitary officer the existence of infectious disease. It was therefore a considerable satisfaction now to find a man like Dr. North saying that compulsory notification had been very successful in the City of York. Dr. Sergeant's experience was also very satisfactory, for although he pointed out that there was still much diversity of opinion, experience showed that information of disease received from the medical practitioner was more prompt and reliable than when coming from the householder; so that whatever method of notification is adopted, the responsibility will in the end rest with the medical man. In most, though not in all of, the districts of London (including the one in which he was located) they had not the system of compulsory notification in force. They might not in London derive *much* benefit from the system, but they would certainly derive some. There were a certain number of cases of small-pox and scarlet fever, but very few, which were not reported, so that with regard to these diseases they were not likely to gain much; but with regard to measles they would probably gain a good deal, because they sometimes got into an epidemic of measles in London before the medical officer was aware of the existence of the disease. This happened to him and he knew it had happened to others. He had indeed been unaware of the disease at all, until death had taken place, or attention had been called to the fact that a large number of children were absent from some particular school on account of measles. There was an impression abroad that they could not prevent the spread of measles, but this impression was erroneous, for it could be prevented spreading both in the household and in the community. How he might be asked could they prevent it spreading in the community? One very effective means was by the closing of schools; by this course they could entirely stop an epidemic, certainly within a very few weeks. Here was another fallacy to which he wished to direct attention. People said, "If you close schools the children will play in the streets and the epidemic will spread still more." That was totally erroneous: the infection did not spread half so quickly in the streets and playgrounds as in the schools. He had found that the closing of the schools in the case of a measles epidemic very quickly had the desired effect. Another important sentence in Dr. Sergeant's paper was where he said: "Water carriage under favourable

circumstances seems to my mind the most complete, most decent, and best adapted for large populations; but many towns from deficiency of water supply, or owing to the condition of the sewers or outfall, are not suitable for water carriage. In such cases some form of pail system should be adopted which will allow the refuse to be frequently removed." He quite agreed with Dr. Sergeant, indeed he was almost going to say it obviously must be so. The great law for the treatment of refuse matter in towns, was that it should be removed as speedily as possible; if this were not done, it became a nuisance, poisonous matters were given off, the air, water and soil became polluted, and the result was great danger to health. There was no method by which the refuse could be got rid of so quickly as by water carriage, and he therefore thoroughly accorded with Dr. Sergeant's advocacy of it.

Mr. E. C. Robins, F.R.I.B.A. (London), was very glad to hear what had fallen from the two last speakers on the pail system, and trusted the time would come when the town in which they were met would give it up in preference for the water system. He had just returned from a trip to Norway and Sweden, and found that in the districts of Stockholm and Christiania the pail system was in use. He had an unfortunate experience. He slept with his bedroom window slightly open, and was disgusted during the night with an awful smell. He enquired the reason of the stench, and was told that the pails had been emptied during the night. He mentioned the matter to the Principal of the Gas Works, and asked his opinion of the system. He replied: "Our system is as perfect as it can be; it is under the superintendence of the police, and it is against orders to remove any pail unless the soil is covered with lime or some other disinfectant." He appeared to be perfectly satisfied with the arrangement, though he admitted that the towns suffered very much from diphtheria. However well conducted, his experience was that the pail system was often a great nuisance, and under some circumstances he would prefer the cesspool system, because it could be ventilated and by the pneumatic process emptied without nuisance. It was stated in Christiania that the pails were emptied about every three weeks, instead of three days, as it ought to be.

Dr. Alfred Carpenter (Croydon) said that for convenience he proposed to commence at the end of Dr. Sergeant's paper. He noticed that in the last paragraph but one the Doctor said, referring to the question of the removal of dwellings: "The Corporation have not cared to provide house accommodation for the persons displaced, preferring to allow private individuals to undertake the responsibility." He thought this was a very important matter, and showed at any rate that the Corporation looked at their responsibilities in the right direction. To his mind it would be a great mistake for the local authority to provide habitations for the people. It would be as great a mistake as it would be for the state to undertake to feed the people. To do

this the local authority would have to step out of its way and from its proper position, inasmuch as it would be taking up a responsibility which belonged to the private head of a family. Dr. Sergeant also touched upon the water supply, and he noticed with great satisfaction that in this respect Bolton was admirably situated. It had an immense volume of water, and thus there was no reason whatever why they should not adopt that more healthy and cleanly way of dealing with refuse, viz., the water carriage for the removal of excreta, rather than the pail system. If it only was dealt with in the proper way, much could be done; and no one who had witnessed the advantages that belonged to the water carriage, as compared with the pail system, could hesitate for one moment in determining that it was by far the more advantageous. But where the water supply was not sufficient he should say that some modification of the pail system was the right one. But in Bolton, where they had a plentiful supply of water, it appeared to him that it would be a move in the right direction to substitute water-closets for pails. Now he should like to turn for a moment to the question of the excretal refuse deposit at Wellington Yard. He could not help thinking that a very large proportion of the £30,000 spent there might have been saved. But the work was now done, and he would not refer further to that matter. But there was another evil to which he should like to draw attention. It was an evil of a very important character. The amount of refuse daily consigned to Fryer's Destructor was estimated at sixty tons. He thought this was an utter mistake. It seemed to him to be wrong on the part of a local authority to do any such thing. It was wrong from an imperial point of view, and it tended materially to damage the interests of our country, because it simply amounted to this: they were destroying refuse which the soil wanted, and at the same time they were complaining of the deficiency of the production of the soil. Owing to this deficiency they had to import from abroad. They ought not to shut their eyes to the fact that whatever the soil would produce the people would consume, and the less we produced here the more we had to import from other countries. He took it therefore, that in destroying material which would help to produce corn and other food, they were doing an evil to the nation which should at once be stopped. If the material produced in their towns was disposed of on the land in the way it ought to be, the land would produce more, and to that extent they would be less dependent upon foreign nations for their food. This was his objection to the paltry profit of £1,000 a year made in connection with Fryer's Destructor, and which was made at a very serious loss to the country at large. The average cost of sewerage under the new system was higher by 1s. 7d. per house than under the old system: a very small amount compared with the mischief which resulted from the old system. To allow the old system to go on meant the continuance of great sickness in their midst and more frequent deaths. Dr. Sergeant referred to the popularity of the Fever Hospital and the good sense of the Bolton people in making it free to all. He also said it showed the good sense of the people of Bolton, because it was of the greatest importance such an institution

should not be a pauper establishment. He was strongly in favour of the early and rapid removal of infectious cases, if possible, to hospitals, and he was pleased to find that they were so favourably situated. Now he came to the important matter of the notification of disease. For the last thirty years he had argued in favour of notification. He thought Medical Officers should have the earliest and most positive knowledge of the outbreak of infectious disease, and that the starting point of this information should be the medical man. But he had always been opposed to the dual notification, as it existed in Bolton. He took it that it was the duty of the medical man when he came in contact with infectious disease, to at once inform his employer of the nature of that disease, and of the measures that should be taken for its repression and for the prevention of danger to other people. It was his duty to notify that fact to the patient's friends, and indeed to all around the case; and it was the duty of the person in charge of the case to make the communication to the local authority. He would grant that it was much better that the notification should be made by the medical man direct, but he contended that that could be obtained without placing the medical man, as he was placed in Bolton, under the thumb, so to speak, of the Medical Officer of Health. It was possible for the Medical Officer of Health to place his medical confrère in the dock, as a defaulter. It was a mistake to make it compulsory and penal on the medical man, and by that means make the rival in practice the inferior in the court of law. There was a better and more satisfactory way of dealing with the matter than by making every medical man a state official. He objected to the principle of making the medical profession state officials. It was a mistake to suppose that the state had to do everything. It was quite right for the state to say certain things should be done, but he did not think it was always called upon to do these things by its officials, to the exclusion of private individuals. The medical man having notified to the patient or guardian or other person in authority that infectious disease exists, had done his duty, and when the fact was kept secret by the person to whom the notification was made, that person had failed in his duty to the state and as a member of the commonwealth. The Medical Officer of Health having become aware of that default, proceeds against the offender, and asks the Court of Summary Jurisdiction to inflict a penalty upon him for neglecting to do his duty. Say the case was one of small-pox. Then the Medical Officer of Health had the power to put in the witness-box the doctor in charge of the case and to put to him this question: "Did you, or did you not, do your duty in informing the person in charge of his duty to his neighbour, viz., to isolate the case and take measures for preventing the spread of the disease?" If he said no, the doctor convicted himself of neglecting his duty to his patient, and it would do him a greater injury than would the 40s. penalty in consequence of his being proceeded against for non-conveyance of the notice personally to the local authority. If the doctor and the patient's friends shut their mouths, however, the difficulty would be extremely great in proving that a particular case was small-pox or scarlatina, when there is a dual clause. Undoubtedly

friction has arisen between the Medical Officer and his confrères, and information was most grudgingly bestowed. The law was working very well, and so was the notification where there was no penalty upon the medical attendant for not reporting, and if a fee was paid for the certificate. If a law were passed which applied to all persons in all parts of the country, calling upon those in charge of infectious cases to report to the local authority at once, and making it penal if they did not, allowing them at the same time to appoint their medical attendant as their agent, and giving the local authority power to pay for the certificate sent in, he did not think there would be any difficulty as to the required notification being carried on; and unless this was done throughout the country, he did not think it would be effectual to the extent they had a right to ask for. This made him fail to see his way to continue the penalty upon the medical profession for failing to do that which these private acts compelled them to do, viz., creating a new crime and making all medical men to be government officials. The medical profession ought not to allow the penal clause to stand as it did; but they must do their duty in telling those in charge of the patient to report to the local authority, and even to do it for them; and for this service they ought to have the right to an adequate fee.

Dr. John Tatham (Salford) said he came from a place which, as a separate Sanitary authority, was possibly unknown to them —a place called Salford, which was probably lost sight of on account of its close relation to Manchester. Nevertheless it was a municipality which contained 218,000 inhabitants; *i.e.*, double the population of Bolton. Since the year 1882 Salford had enjoyed the benefit of notification and hospital isolation, and therefore they had had a fair amount of experience, and he would add his testimony to that of Dr. North as to the advantages of notification. It was agreed that compulsory notification of infectious diseases was not the be all and end all of sanitation, they simply looked upon it as a means, and he begged to say it was a very valuable means to an end. Dr. Sergeant enjoyed the notoriety of having fought the battle of notification in troublous times, and he had fought it fearlessly and well, His own experience was the same as Dr. Sergeant's. Dr. Carpenter's main objection was to the penal clause as affecting medical men, but Dr. Carpenter must excuse him for saying that this objection appeared to him to exist only in the Doctor's imagination, for it certainly did not exist in practice. He was quite sure that when he told them that in five years he had had notified something like 7,000 cases, and that in no instance had he had to go into court against a medical practitioner or against a ratepayer, they would at once agree with him when he said that the act in his own borough had worked satisfactorily. He should like very much to secure, either at the hands of the Registrar-General or from the Local Government Board, a weekly return of the cases of infectious disease which occurred in various parts of the country, in order that from time to time, they might have warnings as to what kinds of infectious disease were

likely to be locally prevalent, and in order that they might fortify themselves against epidemic. At present there were no such returns, but it would be of immense advantage to Officers of Health like himself if such a system could be initiated.

Mr. Councillor John Barrett (Bolton) said that with regard to what had fallen from Dr. Carpenter as to the operations at the Bolton Wellington Yard Depôt, he wished to inform the Congress that by far the greater bulk of the material named as being burnt by the "Destructors" was of no manurial value whatever. He granted that by a careful process of mixing, it would be rendered of such a nature that it would very likely not be objected to by the farmers who took it away. But they had the greatest possible difficulty in dealing with the quantity of manure taken to the Depôt. Very often they had during one part of the year a total stock of something like 5,000 or 6,000 tons. When the happy time arrived foreshadowed by Dr. Carpenter, when all this manure would be required by the farmer, he was sure the Committee would be very glad to dispense with burning anything they could possibly dispose of at a profit. At present they offered farmers in the district the manure at the lowest possible price—they only asked one shilling per ton, but still they had a difficulty of disposing of it even at that low price. He was sure he, as Chairman of the Committee, would be very glad when they could dispose of this refuse in some profitable manner other than cremation.

Dr. J. W. Mason (Hull) wished to speak especially on the question of excremental refuse removal. He represented a town of 196,000 inhabitants, which had possibly a unique position in the history of sanitation. It was what was known as a "privy" town. They in Hull, although not having the pail system, had adopted what they considered an efficient privy; and they had also established a system of weekly collection of night-soil—the Corporation having arranged with contractors who collected the night-soil and dry dust at least once weekly, and removed it outside the precincts of the borough as it was collected. In the whole they had over 40,000 privies. That was a very large number, and the result of the institution of a weekly collection had been that complaints, which had been at one time of almost daily occurrence, had now become very few, averaging only about one a week. He could not do otherwise than congratulate the town of Bolton on the efficiency with which their Corporation had looked after similar matters. It had been said that the death-rate of a town corresponded with the collection of excreta. Whether this was the case or not, he thought he might fully claim that in the town he represented, the substitution of a continuous for an intermittent sewage system and the weekly collection of excreta had been instrumental in lowering the death-rate, which had possibly been one of the highest in the kingdom, so that now the town enjoyed the enviable distinction of being one of the lowest, so far as death-rate was concerned, in any of the urban populations of the country. He

quite agreed that the water carriage system was preferable in large towns where it was practicable. With respect to the compulsory notification of infectious diseases and hospital accommodation in Hull, they had no compulsory notification of infectious diseases; but they had provided one of the most efficient hospitals; and at the present time they isolated more than any large town in England without compulsory measure, and possibly had as many patients in their hospital as some large towns possessed of compulsory powers. His opinion was that those hospitals for infectious diseases, if they were to become as popular as they might be, should, as was the case in Bolton, be free for rich and poor alike.

Dr. C. Macfie (Bolton), remarked that as a medical man belonging to Bolton, it would be as well for him to give an expression of the general opinion as to the application of the notification of the infectious diseases clauses of the Improvement Act in Bolton, especially as they affected the medical profession in the town. Dr. Sergeant said in his paper that the majority were in favour of the notification of infectious diseases. He thought all the medical men would agree to that, but as Dr. Carpenter had said, it should not be the medical man who was called on to report the secrets of his patients. Prof. Corfield had said it was a matter of sentiment. Perhaps it was. Many said the present state of affairs in Ireland was due to sentiment; but it was there, and there was something more than sentiment in it. Still, until the country saw its way to a better plan for reporting the cases other than we have at present, they, as medical men, would have to bow to it. Dr. Sergeant had said that with a small hospital and the prompt reporting of infectious cases, an epidemic of scarlet fever could be checked in the bud. Well, they have had an epidemic of scarlet fever in Bolton for something like twelve months, so far as his memory served him. Personally, he had had cases of scarlet fever under him professionally for many months, so that this did not altogether bear out what Dr. Sergeant said as to checking the spread of the disease by carrying the patients away to the fever hospitals. He said that was quite right in cases where they could not be properly isolated, as Dr. Carpenter mentioned, and they found, as the Medical Officer for Salford said, that there might be exceptions. They found, too, that even the fever hospital was the means of spreading disease. In his own practice he had had two cases within the last two years where the fever hospital had, in his opinion, been the cause of spreading scarlet fever. The cases were immediately reported and were removed to the fever hospital. After the lapse of six weeks they returned home, and within three days scarlet fever appeared in the same house, showing, in his opinion, a want of thorough effectiveness even where cases were removed to the hospital. On the other hand, in all the cases of scarlet fever he had had under his care throughout the case, he had not had one case of another member of the family having been affected. He had had a good many of these cases, but had of course always taken care to secure complete isolation. But there was

another difficulty: very often in the dirtiest cases, and those in which it was most difficult to get isolation at all, they found that the friends of the patient would not send for the medical man under any ordinary circumstances, because they knew that as soon as the case was reported it would be removed to the hospital; and they knew also they would have the sanitary inspector—not Dr. Sergeant, except it were from his office—down upon them. And the inspectors, in the case of Bolton, did not try to explain to and persuade the people that all was for their benefit. They were too imperious, and there was the sense that they were forcing the law down their throats. Then occasionally they found that in some streets where they were attending they would be assailed with "how is it so-and-so a few doors off have scarlet fever and they are not reported?" Enquiries have been made in such cases and the people have denied that the case was one of scarlet fever; and they have acted so, simply because the law was forced down their throats. He said let the law be applied with some consideration for the feelings and opinions of the medical practitioners affected as it was done in York and in Salford; and he was sure the act would be carried out as heartily in Bolton as it was there. The act had been enforced under very considerable feeling, partly because the medical men had to report, and to report under penalty. Dr. Sergeant mentioned that there were other causes tending to the spread of diseases, and from his own knowledge of Bolton he must say that the open ashpits could not be sufficiently condemned. They were a great source of disease in Bolton, and they had a system of allowing the ashpits to run from the beginning of the summer until the end before they were emptied. He had known many cases of choleraic diarrhœa occur where the ashpit had been emptied say two or three days before, and he could not help thinking a great move would have been made in the direction of preventing those epidemics of fever as well as diarrhœa if those ashpits were dealt with. In this connection he would ask that as the members were visiting various places of interest in the town, the scavenging committee would see that they had an opportunity of visiting one of those back streets after the ashpits had been emptied, and he thought they would find they had plenty of foci for the creation of disease. In the same way as there were factors tending to germinate disease, so there were a great many other causes preventing the spread of disease other than notification or the establishment of a fever hospital. They knew for example what great improvements had been made in the town; they knew what great improvements had been made in the country—so much so that it had been said to have added five years—some say 13 years—to the average duration of human life. So that he thought that in considering the sanitation of a town as Dr. Sergeant had done in his able paper, he ought in order to have put his conclusions in a proper light, to have detailed what had been done in the Borough outside the fever hospital, and outside the reporting of infectious diseases, and to have compared his conclusions with the effects of sanitation in other similar towns without notification clauses in their sanitary laws.

Mr. S. W. North (York) observed that he had ventured to move the adjournment of the discussion because he thought it was not well that the observations which Dr. Carpenter had made on the subject of notification should go forth as the sole expression of the views of that conference. He should have dealt with it before if he had thought it to be relevant; Dr. Carpenter had urged that day as he had urged on many previous occasions, his objection to the notification of infectious diseases being enforced on medical men, and had sketched some plan by which he expected that the person suffering or the occupant of the house in which the patient resided, should himself notify the disease. He took it at all events that Dr. Carpenter's objection was to compulsory notification by medical men, and he expected that it would be carried out better if the duty were reposed on the occupier or patient himself, rather than the medical practitioner. With all that Dr. Carpenter had said in his desire to protect the medical profession, he trusted there was no member of the profession more anxious than he to protect their rights; but he was bound to say that if notification was required for the public good, and if it were one of the things requisite for the safety of the people, there was no method which to his mind offered the slightest satisfaction except compulsory notification by the medical man in attendance. As Dr. Carpenter was aware, in the clause adopted as a result of the recommendations of Mr. Sclater Booth's Commission the notification was dual; and what was the experience on that point? During more than three years in which notification had been in operation in York he had never received a single notice from a householder, whilst as to notices from the medical profession they had come in with unvarying regularity, punctuality and accuracy. But the opportunities for evasion on the part of the householder were so enormous that he confessed himself astonished that anybody should rely solely on the householder for notification, or that they should rely on that round-about method by which a medical man should be bound to give a printed form to the patient, and that the patient should be bound to send it to the sanitary authority. It seemed to him better and more straightforward that medical men should send it to the sanitary authority, and if the law imposed upon him that duty, the injustice was not on his part if there was any, but on the part of the law. So with the notification of disease as with the certifying of vaccination he might fairly say, "I do not like this but it is imposed upon me, and as a good citizen I am bound to obey it." And when the medical man did this he disclosed no secret voluntarily any more than did a witness who gave evidence on oath before a court of law. It was most important that this notification should be accurate and reliable; it was indeed vital that it should be so. If it were not, the character of a town might be taken away by the notification of cases which did not exist. No reliance could be placed on the notification of a householder who would always have this excuse that it was unjust to expect him to know the nature of the disease. Then the diagnosis of these cases was by no means so clear as some of them could desire. After forty years experience he frequently came across cases of

infectious disease about which he had considerable doubt, and that which occurred to him must occur to a very large number of practitioners. Well if the medical profession felt doubt now and then as to the diagnosis of some case reported, how much more so must it be in the case of a householder? Let them look at the wide door which would be opened to the neglect of sending these notices. It was all very well to say this was a duty enjoined by the law and so forth; they knew as a matter of fact that amongst the large masses of the poor, and amongst large numbers of those who were not poor, those sort of duties were as a result indifferently performed. Why, these people neglected very often to send for medical advice until it was too late to do much good; in fact in all the social relations of life there were large numbers of them who grievously neglected to do their duty. From the highest to the lowest there was an unwillingness to discharge a duty which they did not like. What a figure they would cut in a police court if a poor woman were summoned for not having notified a case: she would say "I thowt nowt about it; it was nowt but a rash. Bairns will hae rashes, the hae had them afore and will hae them agen"; and would Dr. Carpenter tell them that a magistrate would dare to convict a person saying she did not know there was anything to report or what to do if there were? Let them remember that all this was now written in the local law. It was plainly stated that every householder should notify to the sanitary authority the existence of any infectious disease, and yet in three years he had not received a single notice from anyone except in the medical profession. He said if it were the desire of the medical profession as he believed it was, to do the best they could that men should live happily and pleasantly, and enjoy to the full their length of days, then he said they were discharging a most important and highly honourable duty in giving information to the sanitary authority of the existence of those diseases so that the sanitary authority might do its duty in time and assist them in taking care of the people under their control. The earnest desire of the profession in endeavouring to promote the health of the people is that of which they might be justly proud; without this spirit on the part of the medical profession, sanitary work would soon cease to be the principal agent for good it now was, and none could hope for a brighter future which they expected the advance of sanitary science would give.

Dr. Edward Sergeant (Bolton), in replying on the discussion as a whole, said the matters mentioned in his paper had been very carefully considered, and he was sure it would be exceedingly profitable to them as a Corporation to accept the opinions expressed by the gentleman they had listened to that day. He was himself exceedingly obliged to Professor Corfield, Dr. North, Dr. Carpenter, and Dr. Tatham, and the other gentlemen who had spoken. As to notification, which had given rise to so much discussion, the principle was he thought, accepted by all sanitarians. The mode of carrying it out however, was always a difficult problem to solve. In 1877

when they in Bolton obtained powers, they had that dual responsibility imposed on the medical man and also on the householder; in 1879 they reconsidered the subject, and one of the questions they reconsidered was the question of reporting. From 1877 to 1879 they had a certain amount of friction, and they were anxious to do away with this as much as possible; consequently they desired that the responsibility should be taken from the medical man and placed on the householder; but a meeting of medical men was held, and they received a letter from the secretary Dr. Macfie, who had spoken that morning stating that the medical men would prefer to report themselves, as they thought that by so doing the certificate would "be more likely to reach the Town Hall, and would not run the risk of being destroyed or lost." He was sorry Dr. Macfie who had penned those words was not there as he might have given an explanation. Well, in order to keep faith with those gentlemen, they continued that dual method, and so far as he could see it was the best method; although the act had been in operation ten years they had only had to prosecute in one case. That was an instance where a small-pox patient was kept in a butcher's shop; the patient had been suffering for he thought something like two days. The neighbours suspecting what was the matter owing to the doctor calling, were alarmed; the authorities visited the case and found it was a very acute attack of small-pox, and the butchering business had been carried on during that time. He thought most sanitary authorities would have considered that was a clear case which should be taken in hand; and it was, with the result that they obtained a conviction. That was the only case, and it was furthest from their desire to have any conflict at all; he thought they got on fairly satisfactorily. There was this about dual reporting:—it took away from the medical man any idea that he was violating the privacy of his patient since he was simply performing the duty which his patient or his patient's friends were equally responsible for carrying out. As a matter of fact they rarely exacted a notice from the householder, being satisfied with the testimony of the medical attendant, who therefore assumed a double responsibility. Their opinion was the same as Dr. North's. They very, very seldom got a certificate from a householder, it being generally understood that the medical man would attend to all the reporting; he did not think they had had a certificate from a householder for two years. To adopt Dr. Carpenter's suggestion as to notification it might be necessary to place the medical attendant in the witness box to prove that he communicated to the proper persons the fact that the case was infectious. This course would multiply the difficulties attending notification so as to be manifestly unfair to the medical man. As to the works at Wellington Yard, the material burnt in the destructors was material which had no manurial value; it was rubbish which was quite useless, but which might have become contaminated and offensive owing to having been placed in ashpits. It consisted of vegetable refuse, broken pots, and a lot of rubbish of that kind; so he did not think they were destroying what ought to be placed on the land.

The President, Professor J. Russell Reynolds, said that if Dr. A. Carpenter wished to say anything on the subject they would be pleased to hear him.

Dr. Alfred Carpenter (Croydon), said it seemed to him much better that they should prove to the public at large the advantages of the adoption of measures they as sanitarians proposed, rather than they should get the law to say "you must do this and you shall do that." He knew it helped a medical officer to have the power of saying "you must do it, the law says you shall"; it made the thing go on to some extent very easily; but he asserted this that neither Mr. North, Dr. Sergeant, Dr. Tatham, nor any other medical officer could ever say that they had all the cases reported to them. Whilst the fact was made manifest at this Congress that a large percentage of cases were not attended by any medical man at all, yet there was no attempt made to make the people do their duty of notifying; indeed the eye of the official was shut at the flagrant neglect of duty on the part of the people. Instead of which it should be brought home to them that they owed a duty to their neighbours which they ought in all cases to perform either by themselves or by their agent. Thus the knowledge of preventive medicine would be popularised; instead of as now by the dual notification, the public are made to believe that they have nothing to do with notification.

The President, Professor J. Russell Reynolds, thanked Dr. Sergeant in the name of the section for his paper.

"*Remarks on the History and Progress of Public Health*," *by* John Livy, M.D.

The Council of this Borough have exercised a wise discretion in inviting the Sanitary Institute to hold its Annual Congress here, and I have no doubt that as a direct result we shall make more rapid progress in the diffusion of the knowledge of the laws which govern health and longevity. It requires a considerable time to instil new facts and doctrines into the public mind, and a still longer period before knowledge takes the form of action and legislation. I am however firmly convinced that sanitary legislation will do little service to the country, unless it be the real embodiment of public opinion. I am not sure whether we have not had enough of Law.

Legislation cannot do everything. It cannot make men sober. It cannot abolish poverty, that were too utopian, but it can minimize many of the evils that poverty and drunkenness entail. Hence the value of these voluntary associations.

Mankind have in all ages considered health as the greatest blessing, and have striven, according to their lights to preserve it. The value of pure air, pure water, unadulterated food, and suitable clothing, and in a word absolute cleanliness has been more or less appreciated from time immemorial.

Hippocrates, B.C. 460, the most celebrated physician of antiquity, and styled the Father of Medicine, in his writings discourses freely on their importance, but Moses was perhaps the most practical of all sanitary reformers. He was learned in the wisdom of the Egyptians who were well-known sanitarians. One of the Egyptian commandments not included in the Decalogue was, "Thou shalt not pollute rivers." Moses gave us the principle of the earth-closet, and rules for the isolation of sickness and the disinfection of excreta. We have at this late period only commenced to build hospitals for that purpose and with the happiest results, but so slow has been our progress that we have deferred this inestimable boon to the latter part of the nineteenth century. Indeed the Mosaic Law gives perhaps the best summary of the rules of health to be found among ancient writers.

Considering the absence of the sciences of chemistry, physics, and geology, the Hindoos, Greeks, and Romans, as well as the Mahommedans in their teachings in regard to health were remarkable, although necessarily empirical. According to Strabo, B.C. 50, the streets of Rome were only from 5 ft. 9 in. to 7 ft. 10 in. in width, whilst in order to exclude the sun's rays, the height of buildings varied from 55 ft. to 65 ft. Augustus fixed them at 65, but according to Strabo, Nero reduced them to fifty five.

In climates such as our own, humidity is our great enemy, so that our streets should be wide and straight and the houses comparatively low. They ought also to bear some relation to the prevailing winds and lie parallel with them. Instead of which, in order to enhance the profits of the landlord and the jerry builder, we constantly see rows of houses placed at right angles to each other so as effectually to block healthy ventilation.

The sacred history of the Jews contains references to five famines and ten plagues, and the history of Rome, before the Christian era, to thirty-two plagues. The early history of Greece, too, bears evidence of plague and pestilence.

The plague of Athens, B.C. 428, was one of these, and is the modern plague of England, namely, scarlet fever. In the early

centuries of the present era, we have notices of many plagues among all the nations of which we possess any historic records, and the whole Roman Empire was devastated by mortal epidemics in the second and third centuries, and by the Egyptian plague twice about the middle of the sixth century.

Historians of repute have attributed the decline and fall of the Roman Empire to the pestilences which swept off the adult male population and left the then mistress of the world an easy prey to the Goths and Vandals.

The black death continued its ravages in this country up to the middle of the fourteenth century. Until that time no age or country seems to have been free from severe epidemics.

The plague at Eyam, near the Peak in Derbyshire, is a remarkable instance of an epidemic. It lasted thirteen months, 1665–6. It attacked seventy-six families, and swept away 267 out of about 350 inhabitants, viz., seven out of every nine. It was introduced into the village by one George Vicars, a tailor, who, when the plague was at its worst in London, received a box of clothes from that city. He opened the box and hung the clothes to the fire, and while he watched them was suddenly seized with violent sickness and other alarming symptoms; on the second day he was delirious and large swellings appeared in the neck and groin; on the third day the plague spot was on his breast, and he died on the following night, the 6th of September, 1665. Towards the end of June, 1666, the plague began to rage even more fearfully. There were so many deaths that the passing bell was no longer rung, the churchyard was no longer used for interment, and the church door was closed. The rector, the brave and ever memorable Mompesson, read prayers and preached from an arch in an ivy-mantled rock in a secluded dingle to his people seated on the grass at some distance from each other. All this time, though Mompesson had been visiting from house to house, he and his wife had escaped, but on the 22nd of August, Mrs. Mompesson was seized, and three days after was at rest in the village churchyard. In this terrible month of August, 1666, there were not less than seventy-seven deaths out of a population of less than 200 remaining at the beginning of the month. At least two in five must have died.

According to the somewhat gossiping Diary of Samuel Pepys, the mortality in the City of London reached a total of 7496 in the week ending 31st August, 1665, of whom 6102 died of the Plague. "But," he adds, "it is feared the true number is 10,000, partly from the poor that cannot be taken notice of through the greatness of their number."

In the middle of the fourteenth century this same plague,

under the name of the "Black Death," is computed to have carried off from a fourth to a third of all the inhabitants of Europe.

In London in 1665 it was fatal to 68,596 persons out of a population amounting at the time to half-a-million. The death-rate of London from 1660 to 1679 was no less than eighty per 1000.

LONDON MORTALITY.

1660—1679	80·0 per 1000.
1681—1690	42·1 "
1746—1755	35·5 "
1846—1855	24·9 "
1871	22·6 "
1876—1886	21·3 "

RURAL ENGLAND.

1876—1886	17·9 per 1000.

URBAN ENGLAND.

1876—1886	21·2 per 1000.

In 1870 the Education Act came into operation in this country, and children were for a portion of the day taken out of the close alleys in which they lived, and placed in lofty well ventilated schools, where they could breathe a purer air. The result in London alone was that, according to the tables of the Registrar-General, the mortality of children between the ages of five and ten was decreased thirty per cent., of children between ten and fifteen years was reduced thirty-two per cent., and of those between fifteen and twenty years of age thirty per cent. These results show not only the evils of overcrowding, but also how they can be abated.

The laws of health are most needed where men congregate the most—in our large towns; and their importance increases in a ratio with the number of people living in the same place.

One of the greatest of all sanitary defects is overcrowding. This evil is no new discovery, and legislation upon it is very old. The first and most efficient legislation on the subject was in the time of Elizabeth. She was so startled by the miserable state of the dwellings in London, that she enjoined in her usual high-handed manner that no building within three miles of London or Westminster should be divided into tenements where families might congregate. But long after her reign the tenements of the poor were very wretched. The dwellings of a London workman had no glass windows, no coal fires, and the people slept on straw beds.

Great improvements have taken place in the condition of the working classes since, but rents having risen by 150 per cent. the houses have not improved with the general prosperity of the country.

The mean duration of human life during the present reign has advanced $3\frac{1}{2}$ years.

The services of paid union officers save the country three millions annually.

In France the death-rate is three per cent. higher than in England, which means the loss of 112,000 lives more than in this country.

In Germany, with a mortality in the army the lowest in Europe, the death-rate of the civil population is 6, in Italy 8, and in Austria 11 per thousand higher than here, which means in Germany a sacrifice of 130,000 lives yearly more than in England, and in Italy and Austria 600,000 lives every year over and above the corresponding waste of life in England and Wales.

In an address recently presented to Her Majesty the Queen, by the Association of Public Sanitary Inspectors, the following statements appear :—

"With as yet very rudimentary and imperfect executive arrangements, the general health of your subjects has been far advanced beyond that of any great State of Europe, or the United States of America; that the mean duration of life of all your subjects has already been augmented by three years and a half; that on the last year's population of England and Wales there has been a saving of 84,000 cases of deaths, and of more than one million seven hundred thousand cases of sickness over the average rates of death, and the average sickness rates since the commencement of Your Majesty's reign; that instances of general application have been presented of reductions of the death-rate of the civil population by one-third and one-half; that by more complete application of our science the death-rate of your home army has been reduced by more than one-half, and of your Indian army by more than four-fifths, and that these experiences are available for the whole of the civil population of your Empire, that particular and decided examples have been achieved by the practical application of sanitary science as displayed in district half-time schools, and and by which far greater reductions of the present excessive infantile death-rate may be accomplished."

The massing of the population under good sanitary conditions as opposed to overcrowding, is not incompatible with health as is shown by the Peabody and in Sir Sidney Waterlow's buildings. These houses can be built to render a fair return for the outlay,

and at the same time reduce the death-rate to 16 or 18 per 1,000 or less than the present country death-rate.

A century ago the death-toll throughout Europe was 34 per 1,000, whilst now it has fallen to 22.

In one of the communes of Corrèze, the mortality from 1775 to 1790 was at the rate of 41 to the 1,000, but has now fallen to 24 per 1,000. Similar facts are recorded in Sweden, where the rate has fallen from 28 to 17 per 1,000.

The death-rate at Milan in 1740 stood at 41 per 1,000, it is now 28. At Rome it has fallen from 39 at the beginning of the century to 28 at the present day.

As every death represents perhaps 20 or more cases of sickness, the question is not one merely of mortality. I consider that the civilizing influence of good houses is even greater than their effects upon health.

The unfortunate misconception of the nature and treatment of disease which followed the spread of Christianity in Western Europe, clung to the belief that plague, pestilence, and famine, were divine judgments and ought not to be interfered with by any human agency. They forgot that there is more of mercy than of wrath in all divine arrangements. Undoubtedly epidemics are warnings that sanitary laws are being infringed. Now a God of wrath and pestilence is the God of the Heathen, not of the Christian. It is by disobedience and neglect of natural laws, arranged with supreme beneficence, for our well-being, and not for our destruction that we are mercilessly punished. This misconception has not only retarded the development of rational, but has led to a similar neglect of preventive medicine.

Much of the improvement we observe to-day as compared with the state of affairs in former times, is due to the lives saved from small-pox by vaccination, and by the better sanitary management of hospitals and maternity Institutions. From researches made by Signor Luigi Bodio, similar conclusions may be deduced. In the period 1866 to 1870 of the Italian Conscripts, 36 per cent. were refused for physical defects. In 1881 to 1884 the rate fell to 20 per cent.

M. Charles Monod has estimated that 70,000 lives are saved annually by the agency of our Local Government Board.

Whilst some of the figures may be liable to criticism, there can be no doubt as to the main facts. The Laws of Hygiene are now better understood both by individuals and communities, and however far we are yet from an ideal state, the value of good sanitary surroundings and temperate living is now more generally recognised.

Any one who has visited the ruins of Pompeii and Hercu-

laneum, or even seen photographs of these cities, will at once perceive that in comparison with the houses of the people at that time we may be said to be living in spacious palaces. Almost every one is now on the whole far better housed than at any former period.

Of all the practical sciences Public Health is that which has progressed the most rapidly during these last fifty years, and its progress is in some degree explained by the great importance of its aims and by the certainty with which it attains them. It entirely responds to the aspirations of our time. "Sanitas Sanitatum, Omnia Sanitas," has been in an increasing degree the watchword for that period. In what may be called the centuries of faith, humanity, with its looks turned towards the skies, walked its way regardless of the things of earth. The people lived and died in the most miserable and filthy dwellings.

At a later period, when the disdain of material interests began to abandon them, and when religious fervour was somewhat abated, they began to aspire after freedom and riches.

The taste for the comforts and amenities of life came later. It insinuates itself in societies as the level of the creeds is lowered and that of riches is elevated. Afterwards the care of the future life and that of riches passes into the second rank; the desire of enjoying health and of dying at the latest possible period are placed in the first line. I do not mean to say that the care of health is incompatible with elevation of thought or the highest aspirations of the soul. The contrary is the truth.

Hygiene teaches those who listen to it neither the worship of riches nor the taste for material enjoyments. It inspires them with the love of labour and of family. It teaches men to bring up their children in view of the duties that they will have to fulfil and the sacrifices that their country may require of them. It shows them the road to follow in order to make the rising generations healthy and robust, because their moral and intellectual progress is at this price.

If, occasionally, a person of genius is found in a frail or a deformed body, it is accidental. Strength of will, kindliness of heart, and the more austere virtues are the habitual companions of health and strength. If it is good to have known misfortune in order to have pity upon others, if it is true that people only feel for those evils that they themselves have suffered or which they dread, still misery and pain are bad counsellors. They choke the intelligence and contract the heart. Suffering makes men revolt and become selfish, whilst prosperity makes them charitable.

The services that Hygiene renders are so much more appreciated as they are evident and palpable.

The cure of diseases by remedies has its unbelievers, but Hygiene has none. Her language is intelligible to every enlightened mind. She imposes no sacrifices in exchange for the services she renders. The companion of decency and comfort, she marches in line with them.

The expenditure she necessitates is money well invested, for there is nothing so costly as sickness, if it is not death; and all that is spent in procuring health turns out to be a realized economy.

One of the main elements of happiness is health. It is the possession of no class or rank, and may bless the pauper whilst it is denied to the monarch. Compared to health all the luxuries of wealth and all the trappings of pomp are as nothing. Shakespeare truly says in Henry V. of the poor hind who "like a lackey from the rise to set, sweats in the eye of Phœbus, all night sleeps in Elysium." The sleep that he has earned outweighs the riches of a king.

I cannot conclude these few remarks without adding my humble tribute to the self-denying labours of the late Dr. Farr and Dr. Parkes, and many others still living; and last, but not least, to the renowned Pasteur, whose lifelong exertions in various paths of medical research have conferred lasting benefits upon humanity, and added a bright halo of glory to their own revered names.

Dr. J. F. J. Sykes (London), observed that Dr. Livy had brought out a rather important point in his excellent "History of Medicine." He gave them the fact that medicine was originally an attribute of the priest, and the physician was an after creation. Now the duty of a priest was not only to cure his flock, but his much greater function was the prevention of spiritual disease. Just in the same way the physician had a greater function than curative medicine. He had the function of prevention, and it seemed to him that from time immemorial it had been the duty of the physician to prevent the individual, the family, the community, from running into disease. They recognized the fact that it was the physician's duty to take upon himself certain state functions. They recognized this in their legislature, in their hospitals, both of curative and preventive medicine. The physician had a state trust as well as an individual trust; he was not only the physician to individual patients, but also had charge of the interests of the whole community whilst ministering to one member of it.

Professor J. Russell Reynolds, M.D., F.R.S. (London), said he thought a paper so learned and so interesting was deserving of all

the thanks which a meeting of that Congress could give. Much of it was out of the ordinary line of thought, and there was much within that line, so that it had a double value. He was quite sure the members of the Association would be happy in expressing their thanks to Dr. Livy for his exceedingly interesting paper.

Dr. ALFRED CARPENTER, (Croydon), asked Dr. Sykes whether this country, or whether the church, or whether any denomination or set of ministers, would for one moment agree to the principle that when one of their flock became the subject of some vice, or did something which was opposed to the law of the land, it was any part of their duty to notify that to the state? He thought that at once took out the sting from Dr. Sykes' remarks concerning the compulsory notification of infectious diseases as to it being the duty of the clergyman and the doctor to make known the delinquences of their friends and employers.

On "Our Pioneers," by ALFRED CARPENTER, M.D., C.S.S. Camb.

THE position of the Sanitary Institute towards those who have laid the foundation of progressive sanitary work in this country, may very well engage our attention for a short time during this Congress. It is important for us not to lose sight of the object for which these Congresses are held, and the principle which underlies our actual position. We are enrolled as a Sanitary Institute, for the purpose of popularising a knowledge which must be sound, progressive, and especially that which is actually useful to those who are at work in developing sanitation as a science in different localities. We obtain the facts upon which the edifice as a scientific building should be reared, from experience rather than from theory: but before satisfactory experience can be gained, theory must be promulgated and supported by some kinds of facts, in some cases they may be assumed, in others they have been only observed by a limited number of persons, indeed, sometimes consisting of a single individual.

Fifty years ago sanitary observers could be counted upon the fingers' ends. Their writings remain among us to shew the truthfulness of their observations: some of their works, it is true, are based upon ancient doctrine. The exactness of the deductions

which they made from what they saw, and what they guessed at, can be proved by the experience of the present day. The earliest of our 19th century pioneers have passed away, comparatively unrecognised by the State, and uncared for by the country at large; but they are venerated by those men who have assisted to found the Sanitary Institute, and its necessary colleague, The Parkes Museum. Some, like Chadwick, Simon and Rawlinson, still live to see the results of their labours established upon a firm basis, which becomes all the stronger the more it is examined by the aid of our present advances; others are not now with us in the flesh on this earth, but their mantle is here.

I am led to make these introductory remarks in consequence of the action which has been initiated by the Council of the Institute. They published an abstract of the works of Dr. W. Farr, on "Vital Statistics," in the year 1885. The volume contains a mass of facts which must assist the earnest Sanitarian in all future ages. I am not about to quote from that work, it was well reviewed by your then Chairman of Council, Sir D. Galton, at the last Congress. I hope it is, or will be possessed by all enquirers into sanitary statistics, and especially by the Members of this Congress, but I wish to draw your attention now more especially to the sequence of that work.

The Institute is founded principally for the purpose of popularising sanitary knowledge, to bring its fundamental principles within the reach of the public, as well as to stamp those who presume to act as experts with a stamp which indicates the genuineness of their presumption. The publication of Dr. Farr's works was the result of a suggestion made at the Glasgow Congress in 1883, by Dr. Gairdner. I made it my duty to take up that suggestion, and urge its applicability and the advantages to be obtained from it, upon the council. The sequence of our work was the appearance of the volume and its significant approval by sanitarians in all countries. The council perceived that they should not rest satisfied with an issue of Farr's works alone, and looking over the history of the past, it was impossible for them to shut their eyes to a demand for a continuance in the same path.

It appeared to them that John Simon's writings had assisted to promote true sanitary work, without the actual author being recognised in his true light. They changed the name of the committee to whom was entrusted the publication of Farr's Works, from that of the "Farr Committee," to that of the "Sanitary Publications Committee," and instructed them to bring out an abstract of John Simon's Works provided J. Simon would assist, and approve of the project. This action is a new departure upon a road not at first recognised as suitable for the

council to take, but which events point out as a proper one to be followed in the future. My object in reading this paper is to present the two volumes to your notice which have just been issued from the office of the Institute, and to ask the members of this Congress to carefully read them from beginning to end.

Dr. Farr's Works were compiled from dry statistical records, and are more fitted for consultation as works of reference, and for careful annotation and mental notes than for general reading. John Simon's are readable by the general public, and capable of being understood by the simplest intellect. His reports to the City of London commenced in 1849, dealing with questions of house drainage and cesspool abominations which then existed in the city; the dwellings of the poor; overcrowding; preservation of open spaces; offensive and injurious trades; smoke nuisance; intra-mural interments; a review of the general work of Sanitary Inspectors are all dealt with in a spirit of freshness and vigour which surprises me, even to-day on re-reading them again, though they directed me to sanitary work thirty-seven years ago, when I had the privilege of acting as Mr. Simon's dresser in St. Thomas' Hospital, and of reading his reports in the columns of a London Daily Paper.

Since that time intra-mural interments have ceased, though at the time named more than 2,000 dead bodies were annually interred within the precincts of the City of London, and the whole place was then riddled with cesspools. Smithfield and all its horrors has also disappeared, slaughtering of cattle is illegal, and no longer takes place in the city. Overcrowding is diminished, but it still exists to a serious extent; cisterns are still in use for the supply of water, though a constant supply was insisted upon by their accomplished medical officer of health in 1853; and though the common right of the neighbourhood to breathe uncontaminated atmosphere was urged upon the local authority of that day in incontrovertible terms, it still continues to be contaminated in various ways but too evident to the senses. The strongest Corporation in the world has not been able to put a stop to the smoke nuisance, to intermittent water supply, or to stinking sewers. True the atmosphere of the City of London, except when invaded by smoke from the desert of houses which surround it, may compare very favourably with Bolton, because the chimney-shafts of manufactories do not defile the air as they still do in this part of the kingdom. The smoke from private chimneys is, however, rapidly tending to produce smoke fogs in some parts of the Metropolis, every day in the year according as the wind veres from one point of the compass to the other. Mr. Simon deals with private fire-places in a way that shows the great power of observation which he possessed in 1850 as

well as now. It would be impossible for me in the short time at my disposal to do more than to urge you all to read and digest these remarkable reports, and I may then ask whether public education has really advanced as rapidly as we are giving ourselves credit for. The abominations which existed in the City of London in 1849, continue to exist more or less in many of our smaller towns as well as in some of our large ones. Cesspools; contaminated water supplies; the pollution of the atmosphere by wasted fuel, continue to make their annual tribute to the death roll of the country, in spite of the work which sanitarians are striving to accomplish.

To me, the reading of John Simon's reports is like to the reading of a chapter in history or of some sensational romance; they commend themselves to me for their clearness of expression, and for their striking simplicity, which enabled the City Commissioners to easily grasp some of the most difficult problems of their work, and to do the best they could to educate a changing population like to that which the city always possesses. They have done something, but the most difficult part of their work, viz., the overthrow of vested rights has defied their power, and smoke continues to sit upon the Metropolis like a pall. The smoke nuisance in London as well as in all our manufacturing towns, is a proof that commerce is stronger in its entanglements than is the demand for safety to life.

Mr. Simon also deals with the prophylactive measures to be taken against the invasion of cholera in a masterly style, which shows the firmness of the foundation upon which he worked. Let me read you a short extract as to the specific causation of cholera, written in 1853.

He says: "But, deeply impressed as I am with the importance of these considerations, I esteem it of still higher consequence if measures are ever to be taken for an effective prevention of the disease, that the principle of its *specific* causation, should be stedfastly kept in view. What may be the exact chemistry of this process, I do not pretend to say, urging only that, in all human probability, the poison arises in specific changes impressed by some *migratory agent* upon certain refuse-elements of life. Perhaps, nowhere, and certainly not before your Hon. Court, can it be desirable, in the present immaturity of pathological knowledge, to argue as to the first origin or absolute nature of that wandering influence which determines in particular localities the generation of epidemic malaria. Simply, since it leads to all-important practical conclusions, let this distinction be recognised: that which seems to have come to us from the East is not itself a poison, so much as it is a test and touchstone of poison. Whatever in its nature it may be, this

at least we know of its operation. Past millions of scattered population it moves innocuous. Through the unpolluted atmosphere of cleanly districts, it migrates silently, without a blow; that which it can kindle into poison, lies not there. To the foul, damp breath of low-lying cities, it comes like a spark to powder. Here is contained that which it can swiftly make destructive—soaked into soil, stagnant in water, griming the pavement, tainting the air—the slow rottenness of unremoved excrement, to which the first contact of this foreign ferment brings the occasion of changing into new and more deadly combinations."

We have not advanced much upon this, except to isolate the "migratory agent," and prove the truth of all else advanced in the above doctrine.

Let me make another extract from the same Report. Mr. Simon says to his Court (p. 117, vol. I.): "You will excuse "me, I hope, in consideration of the anxieties of my office, if I "seem superfluously cautious in reminding you that the test of "successful sewers lies in an inodorous fulfilment of their duty, "and that every complaint of offensive emanations indicates, in "proportion to its extent, a failure of that sanitary object (viz., "the removal of excreta) for which the construction was de-"signed."

Go where we will we hear complaints of smells from sewer gratings, from sewer ventilators, from sewer junctions. The sanitary doctors are tinkering away in trying to remove the smell in every town, notably that in which I reside. Thousands of pounds are being spent in trying to remove the effects of an evil which ought not to exist at all, and when it does exist informs us that the constructing engineer has failed to recognise the teaching conveyed in Mr. Simon's Report of 1853, and has not understood the fundamental principle conveyed in the fact that the sewer must be *inodorous* to be successful. So long as they continue to allow of deposit in any part of their course, they are failing in their duty and reflecting upon the ability of those who constructed them. Engineers may rebel at this doctrine, but it is nevertheless the basis of all true sewer work, and Mr. Simon's views should be the view of all of us.

The antagonism to vaccination which is rising among our people from the innate love of liberty which belongs to the Anglo-Saxon and the Scandinavian races, and their detestation of coercion in any form, unless that coercion coincides with their ideas of justice, is likely to give some trouble to sanitary authorities. The publication of Mr. Simon's reports to the Local Government Board, on "The History and Practice of Vaccination," carried up to the year 1871, comes in very op-

portunely at this present time. The reports are readable by the general public, they are written in simple language, they are convincing to the unprejudiced enquirer, and they are now published most opportunely in a form which will place them within the reach of every sanitary authority in the kingdom, whilst the blue books in which they first appeared are scarcely accessible, and many are out of print. If every local authority were to subscribe for the work, and place it at the disposal of the Members of the Sanitary Committee and their Medical Officers of Health, they would make a satisfactory investment and have the facts before them upon which our adhesion to vaccination is based, in a way which cannot be controverted. The report occupies 246 pages of the first volume, and should be read by all sanitary workers, and when possible its deductions should be published in all districts in which objections to vaccination are at this time being used, either for political purposes or personal advantage, or to serve the purposes of personal vanity.

The report upon the sanitary state of the people of England, written in 1858, is like to reading some exciting romance. In that report Mr. Simon clearly proves that "The local excesses "of fatality are due to local circumstances of aggravation. That "those aggravating local circumstances are such as it is fully "possible to counteract, and of the total mortality ascribed to "their influence, a large share is preventable." The simple meaning of that sentence, which I regard as an axiom of sanitary Euclid is, that in any district, whether it be in Bolton, or anywhere else, if the mortality is considerably above the death-rate elsewhere, there is defect of administration, and neglect of duty which should be brought home to someone, and visited by that punishment which public opinion is capable of affording; a tribunal to which alone we have the power of appeal in such cases. But we ought not to be obliged to rest here. The higher mortality is made up of a number of single figures, some of them are induced by a low state of health, for which the local authority is responsible, but others are clearly due to sanitary defects in the home of the deceased person. The work of Simon, and others of his stamp, has proved that such deaths need not occur. The local authority is quite aware of this fact, and I turn to the legal profession for a remedy. The right of action against railway companies has made the seat of a railway carriage the safest place in which it is possible to sit when travelling. I would give a right of action against every local authority when death has resulted from preventable disease, which has arisen in any given locality, and leave it to the latter to recover from the owner of the property if it should be shown

that there was neglect of duty on his part in not complying with the bye-laws of the district in which the property is situated.

But I am leaving the subject of my paper, which is a review of Mr. Simon's reports.

The second volume begins with reports to the Privy Council in 1859, upon the distribution of disease in England, and the circumstances by which it is occasioned, with special reference to diarrhœal and diphtherial districts. As regards diarrhœa, he says: "it is not practicable to give any short analysis except, perhaps, by saying almost in a word that from first to last they constantly illustrate the preventability of diarrhœal death." (Page 7.)

The excess of mortality from diarrhœa has in all places been coincident with the products of organic decomposition, especially of human excreta or the habitual drinking of impure water.

The report of 1860 has reference to lung diseases. He clearly proves that want of ventilation in in-door work-places gives rise to the presence of an atmosphere which specially irritates the lungs. Some businesses set up what are styled "industrial lung diseases," such as grinders and steel polishers, china scourers and potters, cotton carders and flax workers, miners, the unwholesome circumstances of domestic manufacture, such as those of straw plaiters, glove makers, lace makers, and silk workers, &c. Mr. Simon shews that industrial lung disease is preventable, and he asks in forcible language why preventive measures are not adopted.

Mr. Simon thinks that (page 51), "practically it seems certain " that an indefinitely long time must elapse before better results " can be brought about by agencies which are now in operation, " and that year after year as far forward as any present judgment " would unwillingly speculate, the same terrible waste of adult " life, must with no great mitigation continue unless the legis- " lature see fit to provide by special enactment, for more whole- " some conditions of labour."

This is a question which is now very much in the hands of the operatives themselves. If they would return as their representatives in the House of Commons earnest sanitarians, instead of men whose pecuniary interest is against sanitary expenditure, if they would send men like Simon himself, who would work for science sake, and not for the "Almighty Dollar" alone, the working man might see an end to the tribute now exacted by those whose principal consideration is the present profit upon the work done, and a return for the capital invested.

But I must not trespass further upon your time except to point out that you should insist upon your representatives

reading and carefully studying the facts brought forward by Mr. Simon in their various references to the social state of the people of England, as regards the character of their work, and the influence which their food has upon their physique, both bodily and mental.

The rise and fall of values in food is shewn, in other parts of the work, to be accompanied by rise and fall in mortality. A rise in the price of bread stuffs is followed by a rise in the death rate, and *vice versa*. Are we prepared as a nation to allow this rise to be effected by legislative means? Depend upon it, gentlemen, that when profit is purchased by blood, when money is made by the slaughter of innocent women and children, as well as by a death toll of bread winners, there will be a retribution upon those who cause it, just as at this moment retribution is falling upon the landowners of England for neglecting their duty to the poor of this land when bread was dear, and the agricultural value of land treble that which belongs to it now. They took their tithe in paying low wages, and allowing a high death rate to ravage the country. They neglected to provide healthy homes for their labourers, or to give them a healthy water supply, and now we have in many parts of the country land which cannot pay the expense of working and bear its ordinary burthens. We have an agricultural population whose only look out in old age is the workhouse, with the consequent high poor rate, and the flocking of the agricultural population into our manufacturing towns. Surely our landowners will be wise in time, and take measures to bring back the tillers of the soil to the soil which asks to be tilled, and in so doing, they must take the muzzle off the ox who is treading out the corn; that is, if Great Britain is to produce food for the people who live upon her shores. There is an intimate relation between the sanitary state of our bread winners and their families, and the soundness of our political system. Mr. Simon shews us in clear and unmistakable language that national vigour can only be obtained by preserving our national health, and national health is not at the present time in the most satisfactory state, and as a consequence national vigour is declining.

In conclusion, let me point out the enormous work which has been effected in this direction by a very small expenditure. Something less than £2,000 a year has been voted by various governments for experiment, research, and professional enquiry as to the incidence of disease, whilst many millions are being expended in life-destroying agencies. I urgently ask our economists to look favourably upon the expenditure in the former direction, as tending much more to the protection of the

country, by promoting health, than do the millions voted for warlike stores.

Nothing will convince my hearers upon this point so clearly as will the reading of Mr. Simon's reports. I pray you therefore to study them carefully, and to urge all students in sanitary learning to do the same.

Lord Basing, F.R.S. (London), thanked Dr. Carpenter for the eloquent address he had just delivered, and for the good feeling towards the population of the country which his closing remarks exhibited, and still more for the toil he had taken in bringing to their notice in an emphatic manner the admirable reports of Sir John Simon. As he stated last evening to the assembled Congress, Sir John Simon was one of the greatest benefactors this generation had witnessed. He thought Dr. Carpenter had been a little strong in some language he had used in the latter portion of his statement; especially was he unjust he thought in his remarks concerning employers of labour and of the agricultural classes in regard to the conditions of health they found around. It might be said he thought that the knowledge we now possessed upon these questions of public health had been brought about by experience within a comparatively small number of years. Overcrowding and diseases which followed the insanitary condition of our dwellings were not in existence at the time of the plague of London, at all events, not in the same way nor proceeding from the same causes. It was rather extraordinary that with the great number of diseases they had become acquainted with of late years the ravages of them had been comparatively trifling. They were worst in the dark ages, when the population was much more scant and scattered than now, and so free from some of the injurious conditions they now knew to be most rife in producing disease and death. He did not want to be over critical, but in the latter portion of Dr. Carpenter's remarks it was imputed that the agricultural labouring classes were suffering severely from the default of their employers in not providing proper dwellings for them. Far be it from him to deny that it was in many cases true, but he thought in justice it should be remarked, what gentlemen of experience in that room could confirm, viz., that the great majority of the land-owning classes of this kingdom had been for years engaged, and at no small sacrifice, in improving the houses in the villages around them. He considered that in the purlieus of villages and small towns in which labourers for the most part resided, and to which Dr. Carpenter's remarks were justly applicable, the dwellings were for the most part the property of small speculators, who were very fond of expending small sums of money in the erection of labourers' cottages. At all events, that was his own experience in the part of the country in

which he dwelt. Again, Dr. Carpenter seemed to point to the greed of the capitalist classes in extracting to the utmost what they could from the labourers whom they employed, without regard to their social and healthy condition. But he might say from his own experience that some of the most important manufacturers of the country were amongst the most urgent and foremost in pressing upon the government to which he belonged the necessity of works on sanitation. This spirit had been displayed by men interested in alkaline works; and the same might be said with regard to the Act he alluded to on the previous evening for the prevention of river pollution, which could not have been passed into law had it not been with the concurrence of a great number of those manufacturers whose trade and whose industry were undeniably to be interfered with if the legislation were to be put into immediate operation. Speaking generally, he thought they must admit that those who had been foremost in urging the necessity for sanitary legislation had not been so much the sufferers themselves, but rather the benevolent, intelligent, and wealthy employers who had seen the necessity of it. They must not, he thought, be too hasty in finding fault with this, that, or the other class of society, when they remembered that the whole of society had advanced in knowledge and experience to practical results, which they knew had taken place during the last twenty or thirty years. They certainly had a right, and the society was founded for that purpose, to lift up their voices in complaint against shortcomings wherever they could find them, and no one had done greater service in his day than Sir John Simon. He was courageous, unflinching, and determined; and those who were engaged in practical work for the benefit of mankind must know that without enthusiasm and determination a movement lost half its initial force, and so failed in bringing about the results which were desired. He thought Dr. Carpenter's paper would have the best results, as it would induce all of them to study the volumes he had referred to.

Professor HENRY ROBINSON, M.Inst.C.E. (London), expressed his pleasure at the interest which the meeting had evinced on the presentation of the two works referred to, having been associated with Dr. Carpenter on the committee to which the Institute had entrusted these publications. There was one part of the paper to which as an engineer he desired to refer, with the view of protesting against the statement that "engineers may rebel" at the doctrine that the sewer must not be the means of causing deposits or of creating smells. He was sure that every engineer in the room, or who read this, would concur in his protest, as every skilful and competent engineer was fully alive to these evils, and provided against their existence or continuance. There were cases where incompetent people were employed by parsimonious authorities to lay out sewerage works, and failure resulted with the consequent injury to health, but he would object to such people being called engineers in the sense in which the expression would read in the passage to which he had referred.

Mr. H. M. Page, M.D. (Redditch), expressed his obligations to Dr. Carpenter, one of their best known sanitarians, for the splendid address he had delivered that afternoon, especially that part of it which embodied the highest aims that hygiene had in view. It was a fact, however, that at the present day the attainment of those aims were in some sense utopian. For instance, Dr. Carpenter spoke of recovering compensation where it had been proved that disease was preventable. There was no remedy against the authorities in the present state of legislation for this. Speaking from his own experience of rural and small sanitary districts, he could say that one of the greatest defects of legislation and sanitation as they at present stood was that there existed no adequate supervision of the authorities of small districts by the central authority. One of the consequences of this had been well pointed out by Prof. Robinson. Incompetent engineers were called in, and they got sewage and other works constructed which did not fulfil their essential requirements. We want a county or central authority which should exercise more supervision by systematic inspection, on similar lines to those adopted in our educational system. We want the higher officers to be devoted entirely to their work, and independent of the local authority. The higher authority might suggest or direct lines of local sanitary work or enquiry; and at least by inspection on the completion of public works, withhold loans from local authorities where sanitary work showed incomplete or imperfect construction.

Mr. A. E. Eccles (Chorley), said it seemed as if the legislature were determined to keep people in the large towns, inasmuch as a charge were imposed upon all manner of vehicles, either in the shape of rates, taxes, or licences. Agricultural labourers had been driven into the towns to reside under more unsanitary conditions. He thought it would be wise if people who *worked* in towns could be in a position to have their dwelling houses in the country.

Mr. Henry E. Armstrong (Medical Officer of Health for Newcastle-upon-Tyne), said that to most sanitarians the valuable, original, and complete works of Simon and Farr were practically buried. So were to a certain extent those of the Local Government Medical Department, from the time of Simon to the present date—because very few persons knew of them at the time of their issue—and indeed till they were out of print! He considered that large Urban Authorities and Medical Officers of Health, who give all their time to their duty —(to whom these Reports were stock in trade)—should be furnished gratuitously with copies, or at any rate should have early official intimation of their issue. He had written to the Local Government Board (of whom he wished to speak with all respect) to that effect, and had received reply that his letter would receive due consideration. That consideration had been due, and was long overdue.

Dr. Alfred Carpenter (Croydon), in replying, said he thought it a very great privilege to have his paper criticised by a former

President of the Local Government Board, who was able, from his own personal knowledge, to confirm what he had stated to the Congress, respecting the great value of the Reports alluded to from a sanitary point of view. Lord Basing stated that there were cases in which the statement he had made respecting land-owners was true; but that there were many exceptions, and others were being removed. He was quite ready to agree that it was so, and that there were many land-owners doing their duty with regard to the tillers of their soil, and the occupants of small cottages upon their estates; but still the fact remained that there was an immense proportion of the population of this country who were improperly housed thirty years ago. When these Reports were written they were not provided with any water-supply at all; in some cases deprived of the ability to comply with the decencies of life, and also occasionally of the means of living. It was an axiom of the law of England, that the want of knowledge with regard to a certain law, was no defence when raised before a court. It was said by the judges that a man was bound to know the law, and if he did not know it, his ignorance might to some extent diminish the penalty, but he was liable for the consequences none the less. Although the land-owners years ago were not aware of the evils following their want of sanitary directions and hygienic requirements in the case of the poor upon their estates; still, to some extent, they were responsible for the consequences. With regard to manufacturers, he quite agreed with Lord Basing that there were some manufacturers, and some, to his knowledge, in Bolton, who were worthy of the highest commendation for the means they took to preserve the health of their operatives, and for the purpose of raising them in the position to which they belonged. This was all perfectly true, but still there was the fact with regard to industrial districts that there was an immense mortality in this country produced by some ailments which were preventable. It was the object of a Congress like that to make known the knowledge of this fact and to produce the incidence of disease; if they did not point this out and pronounce some judgment upon those who disobeyed them, they were not likely to get that zealous spirit in the actions of the people which was necessary for the removal of these evils. He thanked Lord Basing for his observations, and the kindly manner in which they were made. Professor Robinson's observations he thought confirmed what he had said, viz., that men who called themselves engineers, did carry out works in ways very objectionable; and in the matter of sewers, much mischief was wrought by allowing them to become sewers of deposit. If they got a sewer in this town which gave out odours through the street grids, they might try to deal with those odours by destroying them as they came out, but it was a kind of tinkering which he did not think right; it was much better to go to the root of the evil and prevent the sewers from depositing. He was quite willing to accept Professor Robinson's statement. Dr. Page also made some observations which were very suggestive in regard to the failure on the part of the authorities to do their work under the laws imposed upon them. The authorities ought to do those works, and there was a want of

some kind of machinery by which the higher and central authorities should come into play much more easily than was the case at present, and should supervise the work of the local authority in a more efficient manner than was done, and also that they might be brought into play in a locality by others than those who were members of the local authority. With regard to the observations that fell from Mr. Armstrong with reference to reports being buried, he said they had examined a number of them, and they had been supervised by Sir John Simon himself, who had made additions to the reports here and there. He had seen the sheets when they passed through the press, and had given his support to the work which the Institute had carried out, and in the way he had always been accustomed to do. He had devoted a great deal of time and attention to those works going through the press, and had done it for the Council of the Institute without any thought whatever of reward for himself, except the thanks of the public.

Professor Russell Reynolds, M.D., F.R.S. (London), remarked that there was a vast amount of useful information stored in the blue books, and by a judicious selection from them a great amount of valuable information might be excerpted for the use of members. On this ground Lord Basing had consented to move, and Mr. Tatham to second the following resolution:—"That this section having heard Dr. Carpenter's address on the publication of the reports of Dr. Farr and Sir John Simon by the Council of this Institute, recommend to the Council that there are many other medical essays on Sanitary subjects which at present are only to be found in the Blue books of the Privy Council and the Local Government Board, the publication of which in an accessible form by the Sanitary Institute would very much further the progress of Sanitary Science and practice."

Mr. J. C. Stevenson, M.P. (South Shields), said that he had not the slightest doubt that Members of Parliament would be delighted to forward these books to the sanitary officers of their respective boroughs, as he had himself been in the habit of doing.

On "The Prevention of Blindness through Governmental Agency," by David McKeown, M.A., M.D. (Manchester).

The intimation that a Royal Commission had been issued to enquire into the best means for the amelioration of the condition of the blind gave rise to a feeling of universal satisfaction, and to the hope that it might result in the adoption of measures alleviating the miseries of this afflicted class. So great and

general is the sympathy for these unhappy people that, if the object in view can be attained, few will grudge the necessary outlay.

To minister to the wants and to the sorrows of those who have been stricken blind is humane and noble, but it is much more humane to stretch forth, while it is time, a helping hand, and rescue from the abyss of darkness those who are on its brink. I propose to show how this can be done for a large class of the blind. The most frequent cause of total blindness—blindness of both eyes—is one which can be easily rendered harmless; and this cause is the most important in regard not merely to frequency, but also to the period of its activity, for it may almost be said to come into operation with life itself consigning its victims to lifelong darkness. The cause to which I refer is the inflammation of the eyes which manifests itself within the first few days after birth, and which is known as the purulent ophthalmia of infancy *(Ophthalmia Neonatorum)*.

The ravages of this affection may be classed under the following heads:—

1st. Total blindness, *i.e.*, blindness of both eyes.

2nd. Blindness of one eye, with or without permanent impairment of the vision of the other eye.

3rd. Permanent impairment of either one or both eyes, neither eye being blind.

There are in the United Kingdom thousands of persons totally blind, whose calamity has been produced by this cause. It is not at present possible to ascertain the exact number. A personal visit to all the institutions (public and private) in the kingdom where the blind are admitted would not advance us, because we would leave untouched the large classes of *(a)* the itinerant blind, and of *(b)* those who reside with their friends. Regarding them, the only information available is that supplied by the census returns, viz.: that there are so many "blind at birth," *i.e.*, practically speaking, blind from *ophthalmia neonatorum*. But this is very imperfect; for, as *ophthalmia neonatorum* does not show itself for a number of days after birth, those returned as "blind at birth" form only a part of those who have lost their sight from it. Again, the term "blind" is elastic in its application. For practical purposes it should include all persons whose sight is so defective as to preclude them from entering upon employments for which fair sight is regarded as essential. Such an interpretation would doubtless add a very large number to the ranks of the blind. A person who had "guiding sight" would hardly in a census return be described as totally blind. Even some of the

institutions for the blind in this country refuse to admit any one who can do more than distinguish light from darkness; mere "guiding sight" is a disqualification.

Whilst we cannot determine the total number of those blind from *ophthalmia neonatorum*, we have some interesting data. This affection has been charged with having caused the blindness of—

- 658 out of 2,165 inmates of 22 blind institutions (Dr. Reinhard.)
- 10·81 per cent. of 2,528 cases analysed by Dr. Magnus.
- 37 out of 89 pupils in the Wilberforce School for the Blind.
- 70 out of 217 recorded cases at the Deaf, Dumb, and Blind Institution at Belfast.
- 38 out of 111 cases at the Sheffield Institution for the Blind investigated by Mr. Snell.
- From 33 to 50 per cent. of the total number of the blind in various countries (Dr. Haltenhoff).

Regarding the second and the third classes statistics are wanting; but there is no doubt that the number of those who have lost one eye, or have had the vision of one or both eyes permanently impaired, far exceeds the number of those totally blind.

It is important to bear in mind that the measures for the prevention of the total blindness are also efficacious in regard to (1) the partial blindness (blindness of one eye), and (2) the permanent impairment of vision; and further, that these two classes are numerically much the larger, and that the disabilities under which their members suffer may be such as to mar or even blight their prospects in life.

Practically speaking, these ravages can be prevented. Ophthalmic surgeons are agreed that, if treatment is commenced at an early stage, the affection is within the control of the medical attendant.

The reason why so many persons have become the victims of a disease so manageable is, medical advice has either not been sought at all, or sought when too late. Although the children are probably ill on or before the fifth day after birth, it is often several weeks before a doctor is consulted. The delay is due to the belief that the infants have caught a cold in the eyes, and that it will wear away without doing any harm.

Delay in seeking medical aid—a delay due to ignorance of the danger—is the very essence of the question, and hence the necessity for solving the following problem: What is the most simple and effectual way of removing this ignorance? in other

words, of impressing on the minds of those in charge of new-born infants *(a)* that purulent ophthalmia may occur; *(b)* that it is very dangerous; and *(c)* that if the child's eyes become affected they must be treated, without a day's delay, by a doctor. We ought as far as possible to comply with the following conditions:—

1. Select the most appropriate time, viz., when those to be instructed are watching a new-born infant. The matter will then be presented with a vividness and reality which could not be obtained at any other time, and will have such a practical bearing as to secure the closest attention to the advice given.

2. Offer the information in the form in which it is most likely to be grasped and retained by the mind. That form is undoubtedly one in which the information stands alone, and not mixed up with a number of minute directions which, however valuable in themselves, are, as compared with it, of not the slightest moment. Whatever we wish to impress on the minds of the uneducated classes must be very simple and very short. The following card would answer the purpose:—

Instructions regarding New-born Infants.

If the child's eyelids become red and swollen, or begin to run matter, within a few days after birth, it is to be taken, without a day's delay, to a doctor. The disease is very dangerous, and, if not at once treated, may destroy the sight of both eyes.

3. Give not only written but also verbal instruction where those interested cannot read.

4. Use an agency extending over the whole Kingdom and possessed of the greatest possible weight. Happily, two great state organisations are available.

I desire to call attention to two Governmental plans for the instruction of the public by the distribution of the card already mentioned. The first plan utilizes the provisions of the English, Scotch, and Irish poor-law systems, and reaches with ease and certainty that class which seeks under those systems medical aid in labour cases. In England those provisions are very simple. I need not enter into the details; it is sufficient to state that, in every instance, the relieving officer becomes cognizant of aid being required, or of its having been granted; and Article 215 of the Consolidated Order of 24th July, 1847, thus defines part of his duties: "In every case of a poor person receiving medical aid, as soon as may be, and from time to time afterwards,

to visit the house of such person, &c." The Scotch system requires that in every case in which application for relief is made, the inspector of the poor shall, within 24 hours, either personally or by an assistant inspector, visit the applicant's home.

Thus in England the relieving officer, and in Scotland the inspector of the poor, are available for giving the necessary instruction by reading and handing the card to the applicant for medical aid, or to the person in charge of the patient.

The Irish system is equally simple. Ireland is divided into a number of dispensary districts, each one of which has one or more medical officers, who give medical relief to the poor, but only on the production of a ticket signed by a person duly authorized. Such authorized persons, when giving the ticket for medical aid in labour cases, can read and hand a card to the applicant; the card can be appended to the ticket.

This plan is simple and inexpensive, and, so far as it goes, effectual; it is not, however, comprehensive enough. For the women who do not avail themselves of the poor-law system some other avenue is necessary. It is true the mere reading of one card would lead to a considerable dissemination of the information. This is easily understood by those who know how women congregate upon the occasion in question; still the dissemination thus obtained ought to be accelerated and supplemented; this we can accomplish by the second plan, which is applicable directly to all classes of the community, and is likewise simple and inexpensive.

Parents are required to register every birth within a certain number of days after the event, and the Registrar can, upon each registration, read and hand a card to the person registering. After the adoption of this system only one child in a family would run any risk from the ignorance of the parents. The card given upon the first registration in any family would probably be useless for the child then registered, but it would be an effectual warning for all the subsequent children born of the same parents.

In March, 1884, I read a paper on this subject before the Ophthalmological Society of Great Britain and Ireland, which comprises hospital ophthalmic surgeons in every part of the kingdom, and I moved a resolution recommending the Governmental instruction of the public by the distribution, in the manner I have just described (through the medium of the Poor-Law and Birth Registration Organizations of the kingdom), of the card already referred to.

This resolution was (together with others which I had proposed on the same subject), in June, 1884, unanimously adopted by the society, which in the meantime had had the matter

investigated by a committee. A copy of it was forwarded by the society to the President of the Local Government Board of England and Ireland respectively. The Irish Board took action in the matter so far as the Poor Law System was concerned, but I believe the subject has not been formally brought under the notice of the authorities for the registration of births in Ireland.

The English Board replied that, while fully recognising the importance of the object which the society had in view, they did not consider that they could impose on the relieving officers the duty which the society proposed should be assigned to them. We are not told the reason for this decision, but the obvious inference is that it was because the labour entailed was regarded as an unconscionable increase to the duties of the relieving officer. What then is this labour? Carrying in the pocket a few cards weighing altogether an ounce or two, and occasionally reading one, the reading occupying seventeen seconds! Is it possible this would be the last straw?

Accompanying this reply was a copy of a communication from Sir B. P. Henniker, the Registrar-General, to the Local Government Board, in which he dealt with the proposal so far as the Registrars of births were concerned, summing up thus: "The above considerations lead me to the conclusion that the proposal made by the Ophthalmological Society is not a practicable one." The considerations are three in number, and, as they are rather peculiar, I give them *in extenso.*

The first is: "This would give considerable trouble to the Registrars; and they would most certainly, and not unreasonably, demand to be paid for the service which does not form part of their recognized duties. Say that the Registrar was paid no more than twopence for each card which he read and delivered, the cost in payment to Registrars would nevertheless amount to no less than £7,333 a year, as there are some 880,000 births annually registered." It is well known that in this country one of the most successful methods—probably indeed the most successful method—for strangling any movement is to create the impression that it would be costly. The present objection is formidable in appearance only. Its foundation—the estimated twopenny fee—is of the most shadowy kind, and will not bear the slightest examination. A twopenny fee for 17 seconds! Surprised at this estimate, we naturally turn to the scale of fees actually paid to the Registrars, and our astonishment is certainly not diminished by the examination, which reveals the fact that this scale was absolutely ignored. This fact we recognize at once, when we find that the fee allowed to the Registrars for the labour involved in filling up

(and, where the recipient is unable to read, explaining) the vaccination notice is just one penny. Upon what basis was this monstrous twopenny fee estimated?

The second consideration is: "Again, the person who comes to register a birth at the Registrar's office is by no means necessarily the mother, who will afterwards be responsible for the infant's management. The Registrar would therefore frequently read the card to a person who will have nothing to do with the care of the child's health."

The card is intended to be a warning for the benefit, not, as the Registrar-General supposes, of the child being registered (it would likely be late for that), but of all the subsequent children born of the same mother, so that only one member of a family—the one first registered—would run any risk from the ignorance of the parents. This I have already explained. Did it occur to the Registrar-General that his mode of reasoning was a condemnation of the distribution by the Registrars of the vaccination notice?

The third consideration is: "Neither must it be forgotten that purulent ophthalmia is by no means the only serious affection to which children are liable to fall victims owing to the ignorance of their mothers. If the Registrar of births be employed to give directions as to the mode of avoiding this disease, there seems no reason why he should not equally be called on to read out and distribute directions as to all other ailments to which infants are liable from their mother's ignorance or carelessness; and, in short, to give each mother a discourse on the proper management of a child's health."

I did not think that the simple card of warning could be misunderstood by anyone, much less by the head of a Government department. The card does not give "directions as to the mode of avoiding this disease" (*ophthalmia neonatorum*). It merely points out the danger and the necessity for immediate medical treatment. The views of the Registrar-General upon the public health are curious. To his mind, the ignorance which leads to the loss of sight or of life of a child is of no more consequence than the ignorance which is attended by a slight temporary disturbance of health, and he thinks that, as it is absurd to take any notice of the latter, the former is deserving of no attention. Fortunately, these views are not shared by the State, which does recognize differences and distinctions. It is not necessary to support this statement by a summary of what it has done respecting the public health. The fact will hardly be questioned. The Registrar-General ought to know something about the subject. He should not have overlooked the fact that his department has duties to discharge regarding

that important matter—vaccination. Now the position of *ophthalmia neonatorum* is unique. This is manifest when we consider the definite and restricted period of its first manifestation, its early and unmistakeable symptoms, the widespread ignorance regarding the danger, the terrible results of the neglect consequent upon this ignorance, the lifelong privations and miseries of its victims, the almost absolute certainty of a successful termination of the affection when medical treatment is commenced at an early stage, and the vast good to be done by merely giving a timely word of warning regarding the danger.

I refrain from making any comment upon the awkward position in which the Registrar-General has placed himself by his decision "Not practicable," founded upon the three considerations which I have examined. I am satisfied with showing that the decision and the considerations are, so far as the scheme referred to him is concerned, absolutely worthless.

The only possible argument against the scheme in its entirety is that a small allowance should be made to the Registrars for the reading. This is removed by dispensing with the reading, which was only necessary in those instances where the recipient was unable to read, a class which, thanks to the present system of education, is every year dwindling. In addition, a person who cannot read will be able to find some one who can, and thus learn the contents of the card. The cards can be printed separately, or, if thought desirable, can be appended to the vaccination notice by a perforated attachment, so as to be easily separated and retained. The cost is thus reduced to the printing of cards.

On the 15th of May, 1885, Mr. Russell, M.P., Parliamentary Secretary to the Local Government Board, who was accompanied by the Registrar-General and Dr. Buchanan, received a deputation from the Ophthalmological Society (consisting of Mr. Jonathan Hutchinson the President, Sir William Bowman, Mr. Tweedy, the Secretaries Drs. Brailey and Abercrombie, and myself), which, having entered fully into the merits of the question, suggested that, in order to remove any possible monetary objection, the reading by the registrars should be dispensed with. Mr. Russell, who expressed himself as being in full sympathy with the aims of the deputation, promised to lay before the President of the Local Government Board the views which had been put forward; he intimated at the same time that the Local Government Board had no power to order the Boards of Guardians to do anything, but that those bodies showed great readiness to give effect to recommendations made by the Local Government Board for the benefit of the public.

The Registrar-General said he would have to further consider the matter so far as it related to his department.

No communication has since then been received by the Ophthalmological Society from the Local Government Board. This may be due to the change of Government, which took place a few weeks after the interview. The matter has been before the Local Government Board a considerable time, and it is not desirable that it should remain longer in abeyance.

No question has been raised as to the power of the Local Government Board to direct the distribution by the Registrars; and, so far as the distribution by the relieving officers is concerned, the recommendation by the Board of this step would probably be sufficient. It is reasonable to suppose that, if there be any technical difficulty about the adoption of either of the two plans, the necessary power or sanction will be easily got from Parliament.

Infants of a few weeks—it may be only a few days—old, consigned to lifelong darkness, and to all the miseries, privations, and afflictions which it entails, and sorrowing parents riven with anguish, would form a fitting theme for a powerful appeal to the feelings; but I do not think it necessary to avail myself of it. There is no lack of sympathy—active sympathy—for the blind, and for those who are threatened with blindness, and all that is required is to direct attention to the new and most fruitful field open to us, and to show how it can be wrought. I have pointed out that there is a vast amount of total and partial blindness, and of impairment of vision of one or both eyes, due to *ophthalmia neonatorum*, which is one of the most manageable of diseases; that these ravages are due to delay in seeking medical treatment; that this delay arises from the widespread ignorance regarding the danger of the affection; that, practically speaking, these ravages can be prevented by dispelling this ignorance; that this object can be accomplished by the distribution of a very short card of warning by two Governmental agencies—the Poor Law and the Birth Registration organisations of the Kingdom; and that the cost would be merely that of printing the cards, and therefore trifling.

I might give calculations showing that, by the very small expenditure involved by the plans I have described, the country would be a great gainer from an economic point of view; but such are not needed. Everybody knows that blindness is the cause not merely of a very large annual expenditure for maintenance, &c., but also of a great loss of productive power. We must accept one of two alternatives: *(a)* spend a trifling sum in rescuing those who are threatened with blindness from *ophthalmia neonatorum*; *(b)* allow this disease to claim its

victims and then find the money—no longer a trifling sum—which their condition may necessitate. There is no room for doubt as to the choice to be made. Happily too economy and humanity go hand in hand.

Mr. F. Scott (Manchester) said that Dr. McKeown's paper seemed to ignore the possibility of preventing blindness in some cases without the aid of a medical man. It was obvious that under certain conditions a medical man should be called in; but if it were possible to give information to a parent which would obviate the need of calling in a doctor, that should be done. The Manchester and Salford Sanitary Association had issued a leaflet with that object, and he thought that through the agency of such voluntary associations much might be done to prevent blindness that was the result of ignorance rather than inherited or acquired disease. Governmental departments would naturally resist any such obligations, for when once a precedent was established they would be assailed with all manner of claims for similar help. It would be a course much more likely to succeed than through such an organisation as the London Society for the Prevention of Blindness. Sanitary associations and church agencies should be induced to co-operate in spreading information of the kind provided by the Society just named, and by the Manchester and Salford Sanitary Association. It was not to be wondered at that the matter had been taken up in Ireland by the Government authorities, especially in the South, because there was a great prevalence of blindness there, and apparently no voluntary agency whatever for sanitary purposes. He had been in the South of Ireland during the past few weeks, and noticing the exceptional amount of blindness and eye complaints there, he sent a copy of the leaflet of the Manchester and Salford Sanitary Association to the Cork papers, one at least of which published it in full; and a gentleman in the town—a member of the Board of Guardians—had written to him to say how pleased he was with it, and stating he would reprint it for circulation there. The evil was much graver in Ireland than in Great Britain, and the Irish Board might rightly undertake the reform, while we could not reasonably expect the English Board to do so.

Dr. McKeown (Manchester) explained that the Committee of the Manchester and Salford Sanitary Association had actually passed a resolution approving of the plan he proposed.

On "The Sanitary Registration of Buildings Bill, 1887," *by*
REGINALD E. MIDDLETON, M.Inst.C.E., M.Inst.M.E.

As the Sanitary Registration of Buildings Bill, 1887, has received a good deal of attention in some quarters, while its importance as affecting householders seems to have been lost sight of by those most interested in its provisions, a few remarks on what is proposed to be effected by the Bill may not be inopportune. The object of this Bill is stated to be the compulsory registration of the sanitary condition of all buildings used for certain specified purposes, and the voluntary registration of any other buildings.

A very strong feeling exists, it is thought, that the general sanitary condition of buildings is not what it should be, and as there is at present no means, short of having the building inspected by a professional man at some expense, which enables an intended occupier to know anything of the sanitary condition of the house he proposes to rent; and as in the case of hotels, asylums, and other buildings of this description, even this protection is not afforded, for it is obviously impossible for every visitor to an hotel, every father who sends his son to school or college, to have the sanitary condition of such buildings examined; it is therefore thought that if the owners and occupiers of such buildings could be obliged or encouraged to have their properties inspected, and these inspections registered, such an arrangement would give confidence to the public, and would be of general advantage both to the users of the buildings and to the owners and occupiers; and it is hoped that when these advantages become apparent, owners of houses not included in the list of those which must be registered compulsorily, would see that it is to their advantage to have their properties registered, and would voluntarily take the same course.

Should it be found possible to draft a Bill which would effect this change in the liability of owners, and oblige them to be able to show the satisfactory sanitary condition of their property at any time, and to do this in a simple and efficacious manner without throwing any undue burden on any person or class of persons, it seems pretty clear that a public benefit would be the result. But whether the Bill lately before Parliament would have the desired effect, or would in itself be a public benefit, may be doubted; and the writer is of opinion that the

objections to it, as at present drafted, are many and serious, and it is with them that he now proposes to deal briefly.

The Bill provides that hotels, schools, colleges, hospitals, asylums, and lodging houses shall be put in a satisfactory sanitary condition and registered; but if it be necessary that these buildings should be certified by a licentiate in sanitary practice, it is equally, if not more, necessary and important that boarding houses, restaurants, bakeries, butcheries, dairies, and places of whatsoever description where food is collected, stored, or manufactured, and whence it is distributed, should come under the same category. The first-named places are all more or less subject to publicity in cases of illness or epidemic, but how much evil may result from faulty sanitation in the latter, who can say? To trace any illness arising from bad drainage in the buildings named in the Bill is comparatively easy, in those indicated by the writer exceedingly difficult; yet these latter are entirely omitted from the provisions of the Bill.

The Bill is one of registration only; and although the Local Government Board is specified as the authority under which the Bill should be put in force, if it be enacted, no power is given to that body beyond the registration of the acts of the licentiates in sanitary practice, who, so long as they act up to certain very vaguely defined requirements specified in clause 10, have a free hand and are answerable to no body, and do not draw their power to act from any authority save that of the Bill itself, and their own ability to obtain a certificate or license. This seems to be rather an invidious position for a Board entrusted with the supervision of sanitary matters, and as registering machinery only is required, the writer suggests that such machinery already exists in the persons of the Registrar-General and his Registrars of births, deaths, and marriages; and that this machinery might be used with less friction and to more advantage than that indicated in the Bill.

It is left an open question in the Bill as to who shall bear the expense of the alterations rendered necessary by its provisions, and it may be inferred that, as the occupier would be the person who would have to pay the penalty if the work were not done, and as he would be more easily reached than any other person, he would be made to bear this cost. This does not seem to be just, as, if there be an obligation on the part of somebody, as is certainly implied by the existence of this Bill, that buildings should be in a sanitary condition, such obligation must surely rest with the owner of the building in question; it is therefore suggested that it should be a provision of this or any similar Bill, that the occupier should have power to recover

from the owner in the same or a similar manner as is provided in clause 97 of the Metropolitan Building Act.

In like manner no provision is made for the localising of the charges which would be incurred in enforcing the provisions of the Act, in printing and forwarding notices, in registering licentiates and buildings, and in carrying out the necessary examinations; it is therefore suggested that fees should be charged for each of these acts, with the exception of printing and sending notices, and that any expense incurred beyond the amount provided by the fees should be supplied by the department of the Registrar-General, and should be under his control.

In the Bill before us it is provided that (1) Members of the Royal Institute of British Architects, Members of the Institution of Civil Engineers, and Members of the Royal Institute of Architects of Ireland, *who are registered in accordance with this Act as qualified in sanitary practice;* (2) Architects and Civil Engineers who have been in practice three years at the passing of this Act, and who shall before the first day of January, one thousand eight hundred and ninety, prove to the satisfaction of the Local Government Board that their practice as architects or civil engineers has been a *bona fide* one, and has included the designing and carrying out of constructive works; (3) Sanitary associations incorporated by license of the Board of Trade; (4) Medical practitioners *registered as qualified in sanitary science;* (5) Persons who are medical officers of health at the passing of this Act; (6) Such other persons as the Local Government Board may consider qualified, shall receive licenses in sanitary practice, and that these licenses shall be given free of cost to those who come under sections 1, 4, and 5 of this clause.

What is intended by the words, "who are registered in accordance with this Act as qualified in sanitary practice," and "registered as qualified in sanitary science," is not very clear. If it be intended that clause 9 is to refer to those after whose designation this limitation is placed, it refers to the members of the three leading Institutions, who must be examined by examiners, themselves unlicensed and unregistered, appointed by the respective Institutions, before they can receive licenses to practice; while architects and engineers who do not belong to any Institution have merely to satisfy the Local Government Board of the *bona fides* of their practice and experience. Sanitary associations and medical officers of health are under no limitations at all, and any other persons whom the Local Government Board may consider qualified will receive licenses to practice. If this be the true reading of clauses Nos. 7, 8, and 9, it is so manifestly absurd that it does not require further comment, especially as medical practitioners are required to be qualified

in sanitary science, not in sanitary practice—a very different thing—and no provision is made by examination or otherwise for their registration as having this qualification.

If the interpretation given above be the true one, then the order of precedence stands as follows :—

1. Sanitary associations.
2. Medical officers of health.
3. Such persons as the Local Government Board may consider qualified.
4. Architects and engineers not members of one of the institutions named.
5. Members of the institutions.
6. Medical practitioners.

The highest place in the list is taken by sanitary associations, who, as corporations, have no knowledge whatever of sanitary matters; who do not deal with these things themselves, but through their subordinates and officials; who are practically exempt from the penal clauses which are introduced for the punishment of those who contravene the provisions of the Bill; and who are, as corporations, simply collections of business men who, by joining forces, are able to employ qualified experts to do the necessary work; and who, again as corporations, are able to advertise themselves, which the qualified expert, who does the work, is by professional etiquette prevented from doing. The claim of any corporation to receive a license in sanitary practice is so utterly absurd that the writer does not think it necessary to carry the argument further, and presumes that he has failed to attach their true meaning to these clauses.

If, however, it be intended that all the persons mentioned should receive licenses the position is not much better; there are other professional members of the institutions named fully as well entitled to practise in sanitary science as their brethren who have obtained to full membership, and they cannot do this as corporate members of these institutions, but must get their licenses under section 2, as other architects and engineers. Sanitary associations still retain an equal position with professional men; medical practitioners may be qualified in sanitary science but are not, unless in a few isolated cases, in sanitary practice, and are therefore not qualified to inspect and superintend work, which perhaps more than any other requires practical knowledge to ensure its excellence. Medical officers of health labour under the same disabilities as medical practitioners, and are besides hampered by their official position, and the "other persons" should not exist as other persons; if they wish to practise they can do so as professional men.

To follow these arguments to their conclusion, it is considered that only corporate professional members of the institutions named, to which may be added the Institution of Civil Engineers of Ireland, who have reached the age of 27 years, should receive licenses on application. That architects and engineers who come under section 2 should satisfy the examiners in the same manner as it is here provided that they shall satisfy the Local Government Board. That all other persons shall be required to pass an examination before they can receive their licenses, and that the words corporations and associations should be entirely removed from the Bill.

If such vague and meagre minimum requirements as those contained in clause 10 be considered to be a sufficient protection to the public—and this can only be the case if it be thought that the understanding on this subject is so thorough and general that there can be no difference of opinion—why introduce any such clause at all? If, on the other hand, this thorough and general consensus of opinion does not exist, it is absolutely necessary that the specification should be as full and ample as it possibly can be on broad lines; and this can be no hardship to anybody, for if the consensus of opinion be general, the specification will be followed naturally and without effort; if the consensus of opinion be not general, or if there be any sanitarians who are ignorant of modern requirements, it is the more necessary that there should be a complete and binding specification, to which reference can be made and from which no divergence can be permitted.

In clause 14, it is provided that after the lapse of five years a building shall be considered uncertified; also that any alteration to any building which affects the sanitary arrangements of such building shall render the certificate null and void; but no provision is made for enforcing the publication of such alterations, which might easily be carried out without their coming to the knowledge of the Sanitary Registration Authority, or of any person interested in preserving the satisfactory sanitary condition of any building. It is suggested that the builder or other person who carries out such alterations, should be bound to inform the Sanitary Registration Authority of such alterations being made, under penalty as for misdemeanour in case of non-compliance with these requirements. As the enactment of such a Bill as that under consideration would be likely to give rise to much advertising of ability and readiness to certify for the condition of buildings by those who are not prevented by professional etiquette from taking this course to make themselves known, it is proposed that a clause should be introduced rendering it penal, by loss of license or otherwise, for any licentiate to

advertise, or allow to be advertised, his ability and willingness to grant certificates, otherwise than as is provided for in the Bill, that is to say by the published lists of licentiates; also, as abuses might arise from licentiates who were owners or part-owners or otherwise pecuniarily interested in buildings certifying for their own property, it is thought that provision should be made against this danger, by enacting that no licentiate shall grant a certificate for any house or building of which he is the owner or part-owner or in which he has any pecuniary interest other than as an adviser in its construction.

It is not thought advisable that any penalty should be recoverable before a justice of the peace unless he be sitting in court.

The writer trusts that these few remarks may be sufficient to stimulate discussion, and that thereby valuable information may be obtained which may result in a Bill being drafted and eventually enacted, which shall be satisfactory to all persons interested.

On "The Present Position of M. Pasteur in relation to Public Health," by R. AUGUSTINE CHUDLEIGH.

ONCE upon a time, says an ancient legend, the Plague-dæmon obtained leave to cause 500 deaths in a certain city. But soon the bills of mortality reported the deaths by plague to have reached the number of 3,500. The Plague-dæmon was immediately summoned to account for the extra 3,000 illegally done to death over and above the authorised number. "Sir," said the Plague-fiend, "I confined myself strictly to the prescribed 500. It was not I, but my neighbour, the Fear-fiend, who slew the odd 3,000."

The truth conveyed by this light Italian legend seems quite seriously implied by Marshall Hall in his curious classification of hydrophobia. In his "Principles of Diagnosis" he divides that disorder into two classes, namely, (1) Hydrophobia rabiosa, and (2) Hydrophobia sine rabie. But "hydrophobia without the rabies" sounds so strange, so suggestive of "*Hamlet* with

Hamlet left out," that we might be in doubt as to what Marshall Hall really meant were it not that he commences his 273rd section with the words, "It occasionally happens that we have to discriminate between a real and imaginary case of hydrophobia."

Imaginary hydrophobia must mean, I suppose, hydrophobia induced through *fear;* and though such a thing would seem impossible, yet a brief glance at the literature of the subject shews that the authorities are not few who would account the imaginary cases to be more numerous than the real, who would make Marshall Hall's second class far larger than his first; indeed, there are not wanting persons who deny the existence of hydrophobia as a specific disease altogether, and declare that when any real malady follows a bite, it is due to one or more of the known sequelæ of dirty lacerations, namely tetanus, meningitis, pyæmia, and a host of minor affections in various combinations.

Admitting however, that rabies in the dog, or hydrophobia in man, does really exist as a true, though rare disorder, it must nevertheless be insisted on, that in enumerating cases of rabid madness large deductions must be made from popular totals, seeing that if this species of madness existed in anything like popular quantities, there would soon be not a sane dog left in Europe, nor a sane man either. Reflect how often fever is accompanied by delirium; yet a feverish dog must not be delirious under pain of being accounted rabid.

Think too of the number of disorders wherein the profuse sweats observed in man would be replaced in dogs by foaming at the mouth. Yet a dog which foams is in imminent risk of being accounted rabid. Again, it is a habit with many animals to swallow large quantities of grass, hay, or other fibrous material, to sweep out parasites from the intestine. I have made some interesting observations on this point in cats, dogs, and ducks. And yet the presence of "foreign bodies," in a dog's intestine has been gravely accepted as evidence of rabies. But whether the madness imputed to a dog be real or imaginary, whether it be rabies rabiosa, or rabies sine rabie, as Marshall Hall would have put it, there is not much difference in the result. The terror caused by the cry of "Mad Dog!" so entirely baffles my descriptive powers, that I must borrow the language of William Somervile, born in 1692, who in the poem called The Chace, describes the whole horror from beginning to end in a series of word-pictures, sufficiently graphic to curdle one's blood. After a somewhat remarkable account of the two forms of canine madness, the dumb and the "outrageous," he supposes the dog escaped from the kennel and the

mad race begun. At first a horse is bitten and its death described. Then—

> "Hence to the village, with pernicious haste,
> Baleful he bends his course; the village flies
> Alarmed; the tender mother in her arms
> Hugs close the trembling babe: the doors are barred,
> And flying curs, by native instinct taught,
> Shun the contagious bane; the rustic bands
> Hurry to arms; the rude militia seize
> Whate'er at hand they find: clubs, forks, or guns,
> From every quarter charge the furious foe,
> In wild disorder and uncouth array;
> Till now with wounds on wounds opprest and gored,
> At one short poisonous gasp he breathes his last."

It seems that things were much the same two hundred years ago as they are now, for when the poet comes to speak of treatment after a bite, he laments that—

> "Each hand presents a sovereign cure, and boasts
> Infallibility, but boasts in vain."

His own faith lay evidently in the actual cautery, and thus vigorously does he prescribe it:

> "The pointed steel
> In the hot embers hide; quick, urge it home
> Into the recent sore, and cauterize
> The wound. Spare not thy flesh, nor dread the event;
> Vulcan shall save when Æsculapius fails."

It will probably be conceded that fear has a very remarkable power of rendering people susceptible of whatever disease may be prevalent, and that canine madness is peculiarly calculated to appeal to the imagination, and excite horror and fear in an unusual degree. And it is upon this strangely fascinating disorder that M. Pasteur has been concentrating the attention of Europe for several years. Hydrophobia and rabies have been the great popular sensation upon which the popular mind has morbidly dwelt until it has come to see an angel of death in every dog, and has sanctioned a massacre of unoffending animals, upon which we are already beginning to look back with shame. The laws of supply and demand have been singularly verified. M. Pasteur had a large supply of hydrophobia cure; at once the demand exceeeded all previous records. M. Pasteur created a demand for hydrophobia patients; the supply was such that Pasteur could "claim having saved more lives in six months than were previously threatened by rabies in any ten years."

Now, if M. Pasteur could really cure this malady, all the fuss and fright that he has caused about it would be condoned. But it is the verdict of almost all the civilized nations who have spoken at all, that M. Pasteur is so far from curing or preventing hydrophobia, that he actually causes it. In other words, he not only injures public health by spreading alarm, but he still further damages it by positively inoculating hydrophobia into persons who would have clean escaped if he had only let them alone.

As the public cannot be aware how strong is the evidence against the Pasteurian treatment, I will quote a few of the verdicts, official or semi-official, which competent authorities have pronounced against it.

1. Under the head of "Official Criticism of Pasteur's Prophylactic" the "British Medical Journal" has a paragraph from which I take the following: "The Belgian Government, in consequence of requests made in the Chamber of Deputies, lately deputed three Belgian physicians to investigate and report on M. Pasteur's method of preventive treatment of hydrophobia, and to decide upon the advisability of founding a Pasteur Institute in Belgium. The report of these gentlemen is decidedly averse to such a step."

2. Portugal follows Belgium's lead: for in a monograph on Rabies, published at the "National Press," and appearing "in the form of a quasi-official report to the Portuguese Government," Dr. Abreu attacks M. Pasteur's method, his statistics, his theory, his practice, and even his facts. Indeed, there is scarcely a single point in which he agrees with Pasteur.

3. Austria joins in the revolt. She sent Prof. A. von Frisch to study Pasteur's plan in Pasteur's own home. His report may be condensed into these few words: "Pasteur's original method does not prevent hydrophobia, his second method probably causes it." The result of it all is that the Austrian Government has recently refused to renew the grant in aid of a Pasteur Institute at Vienna.

4. In various communications to the "British Medical Journal" Dr. Spitzka of New York ridicules the position of M. Pasteur. In allusion to the discovery that "foreign bodies" in a dog's stomach do not prove it to be mad, he writes thus: "It was the demonstration of this fact in this city that led to the discontinuance of the New York Pasteur Institute, one of whose chief defenders attempted to inaugurate a hydrophobia scare on the strength of the discovery of foreign bodies in a vagrant cur."

5. A Pasteur Institute has also been closed in Russia, a

country which has suffered heavily from Pasteur's "intense" treatment.

The question now arises, "How is it that, in the face of all this opposition, the whole Pasteurian edifice has not, long ago, fallen to the ground? The answer is that the tottering ruin has been propped up for a while by that astonishing document the Report of the English Commission. That the English verdict is against the evidence, and fully maintains our insular peculiarity, no one who reads what is done in other lands can venture to deny. I unhesitatingly pronounce the "statistics" on which the Report relies, to be among the most preposterous I ever met. Take for example those famous ninety cases, whose details take up fifteen foolscap pages, and on the strength of which M. Pasteur's method is proclaimed a grand success. It will scarcely be credited, but nevertheless it is a fact, that all those ninety cases were treated on an abandoned system—on a system which has been discarded and rejected in favour of a still worse system, which has in turn been discarded itself. Whatever is based on those ninety cases is based on an exploded system, a fact which is enough of itself to ruin the character of the entire report. Another ruinous mistake is that the report calculates the expected mortality (at the rate of 5 per cent.) on the whole number treated, namely, on 2682 persons, and asserts that 130 should have died.

But the expectation should manifestly have been calculated, not on the whole 2682, but on the 2682 minus those who were inoculated "in order to quiet fears," and minus those who were bitten by dogs which were proved not to be rabid, and those who were bitten by dogs pronounced rabid merely because they foamed, or had straw in their stomachs, or were in any way the victims of mistaken diagnosis. Thus, and even more, should the 2682 be diminished before comparing the actual with the expected mortality. Dr. Lutaud, one of Pasteur's own countrymen, has actually made this corrected comparison; and this is his result,—"What then is the benefit of the new treatment? Twenty-five more deaths than if there had been no treatment at all."

I conclude, then, that in spite of the solitary voice of the English Report, the weight of evidence and of argument is strongly opposed to M. Pasteur's "cure." It is time that this bubble were burst. It is for their health that the public should know that hydrophobia is a most rare disease, that there is no good cause for all this fuss and scare, and that the sooner they are diverted from the phantom that terrifies them the sooner will their minds regain their usual tranquility.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

Lord Basing, F.R.S., in opening the proceedings, said he regarded this Conference as one of the most important features of the Congress, and one from which much good would result. In Professor Corfield, their chairman, they had a gentleman occupying a position in one of the most important districts of London where his assiduity and great acquirements were thoroughly recognized. The powers for the government of the health of the country were rapidly passing away from the central office to the local boards, and it was to the agency of the officers who were not unwilling to recognize such control as was necessary on the part of the central government that they must look for a certain uniformity in complying with the requirements of the law; the new system would have a tendency to make the work of public health administration at once uniform and elastic. If that were done with intelligence and tact he saw no reason to doubt that they would make rapid progress in the cause they had at heart.

Prof. W. H. Corfield, M.A., M.D.Oxon., on taking the chair, said it had not been usual for the chairman to deliver an address, but he thanked Lord Basing for his complimentary remarks, and could only say he should be most happy to give what little help he could to the proceedings of the conference. One point to which he wished to draw attention was of very great importance to Medical Officers of Health, partly as such, and partly as persons qualified to give sanitary advice: he referred to the question of the sanitation of houses. There had been two bills prepared for submission to Parliament with the avowed object of providing for the better sanitation of houses, or for the registration of houses for sanitary purposes. They had been carefully considered by the council of the Medical Officers of Health and by the council of the Sanitary Institute, and both had been condemned in toto by them; and, if necessary, Parliament would be petitioned against either of the bills becoming law. In a paper before the Congress which had been printed and circulated, he saw that it was proposed that all engineers and architects should

be considered qualified to certify as to the sanitary condition of houses, but that Medical Officers of Health should not. If Medical Officers of Health were not capable of certifying to the sanitary condition of houses, he certainly did not know who were. With the exception of some half dozen engineers and a few architects who had paid special attention to the matter of house sanitation, he would venture to say that any Medical Officer of Health in that room was better fitted to certify as to the sanitation of houses than were the whole body of civil engineers or architects. This being the state of affairs, he urged upon them not to lose sight of the matter, and not to let slip out of their hands a very important method of improving the health of the people, and a very proper and legitimate source of professional remuneration.

On "Death-causes and their Classification," by FRANCIS VACHER, F.R.C.S., F.C.S., Medical Officer of Health for Birkenhead.

THE intelligent Medical Officer of Health, as year by year he laboriously prepares his tabular statements of mortality classified according to diseases, ages, and localities, is almost necessarily troubled with occasional doubts as to the utility of this work. The information furnished to him through the local registrars as to the ages of deceased persons and the house or place in which each death occurred, is fairly precise and accurate, and yields material for summaries and deductions more or less valuable. On the other hand, the particulars as to the cause of death in the registrar's returns are often other than precise and accurate, and misgivings arise as to their sufficiency for the purposes they are made to serve. The reason of this is not far to seek, for while age at death and place of death are simple matters of fact cognizable without difficulty, the cause of death is frequently a very complex problem to determine even when all the necessary data are given, and a quite insoluble problem when the data are withheld.

From whom then comes the information entered under the

heading "cause of death" in the registrar's records? In other words, to whom is entrusted the important duty, when a death takes place, of deciding what produced death? This question is answered by turning to Clause 20 of the Registration of Births and Deaths Act (1874): "In case of the death of any person who has been attended during his last illness by a registered medical practitioner, that practitioner shall sign and give to some person required by this Act to give information concerning the death, a certificate stating to the best of his knowledge and belief the cause of death, and such person shall, upon giving information concerning the death, or giving notice of the death, deliver that certificate to the registrar, and the cause of death as stated in that certificate shall be entered in the register, together with the name of the certifying medical practitioner.

"Where an inquest is held on the body of any deceased person, a medical certificate of the cause of death need not be given to the registrar, but the certificate of the finding of the jury furnished by the Coroner shall be sufficient."

In short, if the deceased has been attended during his last illness by a registered medical practitioner, the practitioner must notify to the best of his knowledge and belief the cause of death, unless he understands an inquest is to be held. If the deceased has not been attended during his last illness by a registered medical practitioner, a person qualified to be informant for the registration of the death notifies the registrar of the death, stating the name, age, and rank or occupation of deceased, the date and place of death, and adding to the best of his knowledge and belief the cause of death. A death thus reported is registered, and the alleged cause thereof entered, unless the Coroner, to whom the particulars are submitted, in the exercise of his discretion elect to hold an inquest on the same. The official entry as to the cause of death is therefore made on the authority of (1) a registered medical practitioner, (2) a Coroner's Jury, or (3) a person qualified to be informant of the death. It will thus be convenient to consider death-causes under three heads—as certified by qualified medical practitioners; as certified by Coroners' Juries; and causes uncertified.

I. Death-causes certified by Qualified Medical Practitioners, forming about 90 per cent. of the sum of the death-causes registered, are as recorded, infinitely more reliable and useful than death-causes as set forth in the verdicts of Coroners' Juries. Still experience in classifying causes certified by medical men reveals certain defects which it is well to point out, as some at least may be easily avoided. I have found a certain proportion (not a large proportion by any means) of

such certificates embarrassing, and the information they contain difficult to classify owing to :—

(*a*). *Excess of information.* I give a few instances, taken almost at random from last year's record in a small sub-district.

1. "Bronchitis, whooping cough, convulsions" (age $1\frac{1}{4}$).
2. "Rheumatic arthritis, gout, morbus cordis" (age 75).
3. "Acute bronchitis, diarrhœa, debility" (age 63).
4. "Debility, diarrhœa, effects of vaccination" (age 6 months).
5. "Congestion of kidneys, congestion of lungs, œdema of brain" (age 48).

It would not have been difficult to find much more striking examples. Indeed, I have occasionally seen the cause of death certified as due to four or five distinct diseases, so that it might with almost equal propriety have been classed among the zymotic diseases, the local diseases, the constitutional diseases or the developmental diseases. This ought not to be, and medical men in certifying would do well to bear in mind what is the object and use of the certificate they give, and always make it clear on the face of it at least in which class of death-causes they wish the death to be entered.

(*b*). *Deficiency of information.*—Examples of certificates giving incomplete information will occur to many here present. In a recent return made to me the cause of death was ascribed to hare-lip. Last year a death was certified to me as due to urinary fistula, and on a previous occasion I saw a certificate ascribing death to the same cause. Again I find many entries in every year's register in which the deaths of not very old people are ascribed to the effects of age. Thus—man and woman aged 60 "senility;" woman aged 58 "senile decay;" woman aged 50 "atrophia senilis." In people from 50 to 60 years of age there surely must be some more immediate cause of death than old age. Perhaps the most remarkable instance of deficiency of information I have had to deal with, was a copy of a certificate of the death of a married woman under 40 years of age, in which the death was ascribed, by the medical man in attendance, to "natural causes."

(*c*). *Too general terms being used.*—Under this head I especially refer to the use of such terms as coma, without stating the cause of the coma; or apnœa, which is equivalent to saying that the cause of death was "want of breath." I must protest, too, against deaths being certified as due to asthenia, or exhaustion, and to the frequent use of the familiar terms debility and marasmus. Tumour, also, is too general a term, and cannot be classified. Then I have often seen the cause of death ascribed to "stroke," and "confinement," and "stricture,"

and I interpret the terms as best I can, entering stroke to "paralysis," confinement to "childbirth," and stricture to "stricture of the urethra." However, the certifier should not thus leave his meaning to be guessed.

(*d*). *Symptoms rather than diseases being certified.*—Familiar examples of this form of defect in certificates are ascribing the causes of deaths to jaundice, dropsy, hæmorrhage, syncope. Jaundice is, I take it, always merely a symptom, and so is dropsy, even though a place is found for them in the official nosological tables. Surely, in dealing with dropsy, a certifier should do his best to trace the cause. Is it heart disease? Is it kidney disease? Is it liver disease? Is it ovarian disease? Is it a sequela of scarlatina? Is it anæmia or scorbutus? As for hæmorrhage, it may mean almost anything—aneurism, varicose veins, placenta prævia, &c., &c. And syncope, which it is usual to class with heart disease, may after all indicate something quite different.

(*e*). *Undue reticence.*—This defect probably contributes more than any other to the imperfections of the death returns.

In particular there are three important death-causes, primary causes, which, if I may be allowed the expression, are conspicuous by their infrequent appearance, these are alcoholism, syphilis, and childbirth. According to the returns, I find not one in two hundred deaths is due to alcoholism, a deduction which obviously does not correspond with the facts. Deaths from undoubted alcoholism are ascribed to phthisis, bronchitis, pneumonia, brain disease, cephalitis, apoplexy, paralysis, dropsy, heart disease, Bright's disease, gastritis, enteritis, dyspepsia, stomach disease, hepatitis, cirrhosis, liver disease, &c., &c., without a suggestion that intemperance was even remotely connected with the fatality. Similarly, deaths from undoubted congenital syphilis, are certified as due to tabes mesenterica, convulsions, skin disease, marasmus, atrophy, &c., without a hint as to the constitutional vice, the indications of which are not usually difficult to distinguish. As for syphilis which is not congenital, it would appear as if no one ever did die of this except the inmates of a lock hospital, and an occasional parish patient. Of course it is the easiest thing in the world to account for this *suppressio veri.* Patients and their friends (gentle and simple) are endowed with a more or less acute sensibility, and prone to resent any slur on the family sobriety or continence. Even if it were not so, is there one medical practitioner in a thousand who has the brutal frankness to give a disgusting or offensive certificate to the weeping widow in the first anguish of her great bereavement, or the sorrowing son mourning the death of a parent?

Why a large proportion of deaths from childbirth are not recorded as such is by no means so easy to explain. Indeed, to me it is almost inexplicable. However, this is the fact that year by year many hundreds of deaths from childbirth are certified as due to eclampsia, peritonitis, albuminuria, hæmorrhage, &c., without any mention of the recent parturition. Take my own district: one year I find a total of nine deaths ascribed to childbirth, miscarriage, puerperal fever, &c., &c.; and another year a total of eleven deaths to these causes, *i.e.*, one death in childbirth to 345 births and 277 births respectively; and it is not alleged that Birkenhead is any exception to the rule in this matter. Indeed in most districts, if not all, it would seem that death certificates are unduly reticent on this subject of childbirth, women delivered being certified as dying from various causes, without mention of the fact that such causes followed hard upon childbirth. The mortality in children according to M'Clintock is 1 in 123; and the conclusion of Matthews Duncan, who has investigated this question with great care is very similar, viz.: that "not more than 1 in every 120 women delivered at or near the full time, die within the four weeks of childbed."

Having pointed out what I consider the defects in a minority of the certificates of death-causes furnished by medical men, it is well now to make some suggestions as to remedy, before I pass on to the second part of my subject. As regards excess of information, I would propose that when three or four death-causes are entered in a certificate, the writer should indicate how he would have the death classed, by underlining one or other of the causes recorded. As for deficiency of information, using too general terms, and certifying symptoms rather than diseases, all that is wanted is a little more care in writing certificates, and even occasional reference to Dr. Farr's nosology, or the nomenclature of diseases prepared under the direction of the College of Physicians. It would be well also for practitioners to make it a rule never in any case to certify the cause of death as due to exhaustion, coma, apnœa, &c., and to hold that senility or old age, is as a rule an inadequate cause of death for a man or woman aged 60 or under.

In the matter of the *suppressio veri* which seems to be required of the certifier when the cause of death is alcoholism or syphilis, I would remark that the difficulty only arises because it is the custom to give the certificate to a near relation of the deceased. If it were the practice for the certifier to send or deliver the certificate direct to the district registrar, it would be much easier for the certifier to tell the whole truth; and in many cases he would be under no temptation to do

otherwise. I am aware that certifying something less than the naked truth is not always a reserve in deference to mere sentiment, but that certifying alcoholism or syphilis may sometimes invalidate an insurance claim on deceased's behalf. Still, I cannot doubt but that a very slight alteration in the Registration of Births and Deaths Act, requiring the practitioner in attendance on deceased during his last illness to send to the district registrar a certificate of the cause of death, instead of furnishing the same to "a qualified informant of the death," would be a useful legislative amendment, and helpful to practitioners in facilitating the performance of an unpleasant duty. As to the omissions referred to in certifying deaths due to diseases or conditions incidental to tedious or complicated travail, the rule should be to notify the fact of parturition or miscarriage in every certificate stating the cause of death of any woman who may die from any cause within twenty-eight days next following parturition or miscarriage.

One word here as to the obligation on medical men to certify. The clause of the Registration of Births and Deaths Act (clause 20), which I have already quoted, is I think capable of a more liberal interpretation than it usually receives. It may well happen that a practitioner, whose attendance on a patient during his last illness has been limited to one or two visits, may be unable to assign a cause of death. He may indeed have attended deceased for a considerable time, and still be in the dark as to the cause of death. Indeed, death has so many phases, and some are so difficult to interpret, that occasionally even after the assistance of a *post mortem* examination of the body, a practitioner may find that the problem as to the cause of death is still obscure. Under such circumstances, is a practitioner required to certify something? It seems generally to be held that he is, but I am of a different opinion. He is only bound to certify the cause to the best of his knowledge and belief, and in the cases supposed to the best of his knowledge and belief he can assign no cause.

II. Death-causes Certified by Coroners' Juries.—These might be, and should be, as reliable and satisfactory in every way as any death-causes in the registrars' returns. As it is they are most inadequate and unsatisfactory, so that a large proportion of them have to be entered in the summaries under the headings "violent deaths not classed," and "causes not specified or ill-defined."

The verdicts of Coroners' Juries are difficult to classify and comparatively useless for various reasons—that is to say owing to:—

(*a*). *The only question proposed for solution being commonly,*

Is the death the result of disease, accident, negligence, suicide, murder or manslaughter?" Thus the inquiry is not into the cause of death, but only whether anyone is to blame for the death. The court which aims at doing so little actually does less, and often such verdicts as "found drowned," or "found dead," are returned, and these answer no question, except the question of the competency of the tribunal. I cannot help thinking that Coroners' Juries taking this narrow view of their duties is due to the vast majority of Coroners being lawyers instead of medical men. Whether the deceased died of apoplexy, heart disease or thrombosis, is to the legal mind a matter of supreme indifference. Questions of culpability and negligence are the real issues before the Court, from a legal point of view, and the Lawyer-Coroner is sure to instruct his jury accordingly. Even where evidence as to the actual cause of death is available it is perhaps not called, or if called misunderstood. This brings me to another chief cause of the unsatisfactoriness of the verdicts of Coroners' Courts.

(*b*). *The evidence of a medical witness is only occasionally required.*—Holding an inquiry into the cause of death, without any medical evidence whatever, as is so often done, is a travesty. It is like celebrating a wedding without the groom. The result cannot but be barren and unfruitful. Omitting to require medical evidence is in part due to legal, and sometimes medical, Coroners not comprehending the necessity for it, and in part prompted by a wish to save the county or borough rates where practicable. The fee of the uncalled medical witness is saved, but owing to this saving the fees of the Coroner and Jurymen are lost. Economy of this kind defeats itself. For similar reasons

(*c*). *A post mortem examination of the deceased is seldom ordered.*—Were medical evidence called at every inquest, and a *post mortem* examination of the body the rule instead of the exception, what a very different value one would attach to the findings of juries. I am not prepared to assert that a *post mortem* examination is necessary in every case; but I would have a medical witness called in every case, and practically it should rest with him to say if such an examination were needful. As it is, the Coroner orders a *post mortem* examination only when he thinks it is required, and it often happens that he is incompetent to decide such a question, seeing that few Coroners are qualified medical men, and not many of these are in practice.

(*d*.) *Such findings as "Died by the Visitation of God," or "Natural Causes" being usual.* To say that such verdicts are useless is to understate the facts, they are harmful because

altogether deceptive. A formal judicial inquiry is held, and when a verdict is given the assumption is, that the investigation has been brought to a successful issue, but such a verdict as either of the above decides nothing. The first is merely a pious admission that providence overrules events; it has no further meaning, for is not death always by visitation of God? A man dies of bronchitis or fever, or is bludgeoned by a burglar; in each case his death is a visitation of God, just as much as if he had been struck dead by lightning. Death by visitation of God is then meaningless, because it is all-inclusive. It is not less or more than the truth, but "the truth in masquerade."

And what shall be said of the other conventional verdict, death from natural causes? This is certainly not all-inclusive. Indeed, very few diseases are, strictly speaking, natural causes of death. The so-called preventable diseases, such as typhus, typhoid fever, and diphtheria, are not, nor are the large group of maladies classed as tubercular diseases. Then the long list of diseases which are the more or less immediate result of intemperance or incontinence, though frequent causes of death, are certainly not natural causes. Indeed it is far easier to say what are not than what are natural causes; yet apparently the term as used by Coroners' Juries simply means that the death was caused in some way other than by violence, *i.e.*, that the death was not the evident and direct result of chemical or physical forces.

(*e.*) *The little respect commonly accorded the Coroner's Court.*—This is assuredly a cause of the useless and unsatisfactory verdicts recorded. A Court which takes a low estimate of its own functions, and often does its work in a somewhat perfunctory manner, can scarcely command respect. The Coroner is a judge without the authority or prestige of a judge; the Jury is a sort of scratch crew; the court-room is a parlour at a public-house. Sittings are not rarely enlivened by sparrings between the Coroner and the Jury, or a local solicitor. "Crowner's 'quest law" is a byword of contempt, and even the censure of the Jury carries no weight. The Court is a relic of very ancient times, and badly needs reform.

III. Death-causes uncertified.—These are, of course, the least reliable and satisfactory of all death-causes. The cause is communicated to the registrar by the informant who reports the death. The informant is a relative of the deceased present at the death, or in attendance, or dwelling in the sub-district in which the death occurred, or a person present at the death, or an occupier or inmate of the house in which the death occurred, or the person causing the body to be buried; and the information as to cause of death which he communicates is either merely his own personal opinion, or it is vouched for by

a quack, a herbalist, a nostrum-vendor, a midwife or nurse. It is especially noteworthy that a very large proportion (about 90 per cent.) of the uncertified deaths are the deaths of infants and very young children. The causes most frequently assigned appear to be debility, bronchitis, and premature birth. Causes assigned in this way are really valueless for statistical purposes, but assuming that they are proximately true, the questions arise: How many of these cases of alleged debility were due to bad or insufficient food? How many of these cases of alleged bronchitis were due to insufficient clothes or exposure? How many of these cases of alleged premature birth were due to parental vice, or the use of abortifacients? Alas, for the little ones! Yet if the death of an infant may be so easily recorded, and the body buried without any efficient enquiry, is it not offering a premium to all sorts of evil practices? And, unfortunately, owing to the many burial societies competing for the custom of the poor, no mother can remain ignorant that money is to be made out of the sacrifice of these struggling little lives. If proper professional advice is not obtained for an adult when sick, it may be and often is owing to his own default, but if it is not obtained for a sick infant, it is obviously referable to the neglect of others: and so manifold are the means of obtaining free medical relief in the present day that few can plead poverty as an excuse for not procuring skilled advice on behalf of a sick child.

That the causes of many deaths marked "uncertified" are furnished to the informants by irregular medical practitioners is indicated by the causes assigned. For instance, in my own district, during recent years uncertified deaths have been ascribed to the following diseases, among others—rubeola, cynanche trachealis, tabes mesenterica, hydrocephalus, ascaris lumbricoides, laryngismus stridulus, diphtheria, typhus fever, encephalitis, pneumonia, paresis, enteritis, cirrhosis, hypertrophy, atrophia and foramen ovale persistent. These terms, and such as these, could only be employed by persons laying claim to some knowledge of medicine. Indeed I know for a fact that some quacks fill in, sign and deliver regular certificates; and if the main contents of such a certificate are entered in the register, what does it matter to the quack whether his name or the word "uncertified" completes the entry? The quack's certificate is received and his diagnosis adopted by the powers that be. Will his customers after such testimony ever venture to doubt that he is duly qualified? Once in my district the cause of death, "uncertified," was attributed to suppression *or retention* of urine. If the certifier had himself treated the case, he must have an amount of assurance rarely surpassed.

What then is the remedy for the defects in the registrars' returns which result from uncertified death-causes being entered in the easy way now so common? The problem was solved nineteen years ago by Mr. (now Sir John) Simon. In his eleventh report to the Privy Council, referring to knowledge which ought to be had concerning the deaths of the population, he writes :—

"First, in my opinion, the law ought, as far as practicable, to require in every case of death that the cause of the death be medically certified. Exception, not in substance but in form, might have to be made for cases where Coroners' Inquests are held; *i.e.*, the verdict of any such inquest must, of course, be understood to include the substance of any required medical certificate. And possibly, for very exceptional circumstances, it might be desirable to provide that, in them, any magistrate's order should exonerate from the necessity of the certificate. But, subject only to such qualifications as these, it seems to me that in all cases of death a medical certificate of the cause of death ought to be required; a certificate to be obtained, where practicable, from the medical practitioner who attended the fatal illness; or, where there has been no medical attendant, or none from whom a certificate can be obtained, from the public health-officer of the district."

Somewhat similar advice is tendered by Dr. W. Farr in his letter to the Registrar-General on the causes of death in 1867. His words are :—

"Where death happens in such circumstances as render it impossible to obtain a satisfactory certificate from a medical man in attendance, the cause, I submit, in the interests of science and of human safety, should be investigated by a medical officer specially appointed in each registration district."

Had effect been given to either of these proposals in the Registration of Births and Deaths Acts (1874), as might and should have been done, there would have been no occasion to complain of the imperfections of the mortality statistics due to uncertified deaths. What has thus been suggested is actually in practice in some towns in the United States. In Boston, for example, the city physician (the local health-officer) is required "to report to the city registrar, when requested by him, the causes of death of all persons dying with no physician in attendance."

Gentlemen, the topic I have selected is not unimportant, and may be considered from many points of view; I commend it to your careful attention. In the brief space allotted to a paper, I have been able to do no more than introduce my subject. I trust that many present may be able to add the

results of their experience, knowledge and judgment, and that the discussion may not be unproductive.

Professor W. H. Corfield (London) said that they were much obliged to Dr. Vacher for his most important and valuable paper It was on a subject with which they all had to do, and they could sympathise with him in the difficulties he had experienced in assigning to deaths their right places in the mortality tables, although for his own part he had had no such difficulty for some years. The late Medical Officer for the City of London had fallen foul of the Registrar General and declined to forward the returns. The result of that had been that his Local Authority decided to have only returns of deaths from communicable fevers and from diarrhœa, but to have these direct from the Local Registrars without any delay.

Dr. Harris (Birkenhead) said what would help them more than anything else with regard to the uncertified deaths, was the suppression of the herbalist and quack. In the earlier quarters of last year, Birkenhead stood second or third highest on the list in the per-centages of uncertified deaths; he at once communicated with their Medical Officer, and was informed it arose from the large practice of an irregular practitioner possessing some bogus degree. That man, not through any medical difficulty, but by reason of some offence against the moral law, got into trouble and was sent to prison; the next quarter the uncertified deaths fell fully fifty per cent., clearly illustrating the large share this element bore in the unsatisfactory certification of the cause of death. He thought Sheffield, Oldham, and Halifax now stood high in the list, and the views of representatives of those towns on the subject would doubtless be listened to with interest.

Lord Basing, F.R.S. (London), said some of the observations of Dr. Vacher reflected upon the provisions of the Registration Act of 1874. Of course that Act might require amendment, but he could only say that the points alluded to as to who should be called upon to certify the cause of death, and in what relationship the medical practitioner should stand to the near relatives of the deceased, had been most anxiously considered, and that the section quoted had been made out after careful enquiry, and the weighing of all the circumstances adduced. In addition there had been a good deal of consideration with regard to the classification of diseases, and how far it should be made incumbent upon the medical practitioner to certify in accordance with the classification, and if he remembered aright, it had been pointed out that there was a good deal of difference of opinion as to classification, and that it would never do to oblige the medical pro-

fession to adopt one or other of the suggestions made. He believed Dr. Farr's was most in vogue, and he understood that some diseases had taken a different aspect or had been attributed to different causes of late. As a matter of criticism however, he should like to point out that Dr. Vacher began by the admission that in 90 per cent. of the cases that came under his notice the medical certificate had been given, and therefore his observations on the shortcomings of Coroners and Coroners' Juries and the unsatisfactory character of the certificate to which no medical man subscribed, to which he entirely agreed, only applied to the remaining ten per cent., a fact from which he certainly took comfort. If the Registration Acts had brought about registration to the extent of 90 per cent. by medical men, the achievement had been a great one, and the effort ought not to be overlooked or regarded as futile. With regard to the law as to Coroners and Coroners' Juries, its condemnation had been general for years and years past. Everybody knew it required to be thoroughly reviewed and reconsidered, and he supposed the time would come when legislation would be attended to in this direction. The appointment of Coroners, the places where inquests should be held, how certificates should be given, and whether the Medical man's opinion should be sought would have to be considered, and one only wondered that anything so irregular and unsatisfactory had been allowed to go on so long unamended. It was also a subject of consideration whether there should be, as indicated in the paper, a medical gentleman appointed to every district, whose authoritative certificate should in all cases be required. They now had a Medical Officer in all districts over the country, and whether he might take a more authoritative part in the obligation of providing a complete registration of disease was a matter very well worthy of attention. They scarcely knew how the profession generally would take the proposal, but the time was come when some arrangement of that kind should perhaps be adopted. At all events they would agree with his remark as to the status of the Medical Officer, and although there was an indication of jealousy as to the Medical Officer regarding himself as a state servant, yet if the improvements in their public health administration were to go on, something more in that direction might be expected.

Dr. Alfred Carpenter (Croydon) said the paper was one which commended itself to the audience, and he was very glad they had the presence of the late President of the Local Government Board, that he could hear what might fall not only from Medical Officers of Health but from others who, like himself, did not occupy that distinguished position. He would only deal with three or four subjects referred to. He hoped to see the Medical Officers discharging more important and more onerous duties than they had yet done. The question as to Coroners and Coroners' Juries was one which, to his mind, must be dealt with in any Local Government Bill brought before the country. There was a suggestion made that Coroners should be medical men. It was thought by some that Coroners' Inquests should be held by medical men because a question as to the

cause of death came into play in every case. He doubted whether it would be to the advantage of science or the medical profession that such a course should be adopted, but he was prepared to support a proposal that every Coroner should have at his command the services of a thoroughly and highly educated medical practitioner, who should sit by his side in his Court and act as an assessor; and he (Dr. Carpenter) contended that that man ought to be the Medical Officer of Health, who should have charge of an area large enough to provide a sufficient salary. The question of registration of death was also connected with the office he held, but whilst it was required that every death should be registered, it did not follow that there should be a public notification of the cause of death, which might in some instances be offensive to the relatives of the deceased. It would be to the advantage of medical science if the cause of death certified by the medical attendant should be sent direct to the Medical Officer instead of to the local Registrar, and that the causes of death so registered should be distinct from the fact of the death itself. Dr. Vacher referred to the difficulties of registration in consequence of the obscurity of the language used, and the difficulties that he had in appropriating each to its particular column. He was afraid that this was a general complaint, and expressed his disapproval of the terms employed in the nomenclature issued by the College of Physicians, giving its hundreds upon hundreds of causes of death in directions which were practically useless for scientific assortment. This was anything but satisfactory to him and did not reflect much credit upon the College, because there were cases in which the real cause was completely hidden. Take cases of death registered as pneumonia or bronchitis, which meant nothing but a local manifestation of some general disease; and a case of death from pneumonia was often registered as a lung disease, which might have been caused by syphilis, by alcohol, by rheumatism, by gout, by tubercular disease or by some miasmatic influence producing the general class of fevers. The cause of the disease was the matter of importance: the question whether its local manifestations were lung or heart was of no moment compared with the conditions under which the disease arose. Dr. Vacher alluded very forcibly to alcohol as a cause of death: it showed its influence in diseases of the liver, the kidneys, and other organs of the body, and until they knew something as to the end and the commencement of the disease, and the particular conditions that first arose, the local origin was of very little importance. Under the circumstances he had described it would be a great advantage to science if they could get a more simple nomenclature of disease than that issued by the Royal College of Physicians, which was more closely connected with fashionable diagnoses than with science. Dr. Carpenter then said he was led to make these observations because he did not belong to the Medical Officers of Health, but he did anxiously desire to see them occupy that high position as disease preventors which it was their duty to hold, in order to take every measure in their power to prevent the development of disease whenever and wherever practicable.

Mr. S. W. North (York) said that it seemed to have been forgotten that the whole basis of their position and knowledge in this matter was the Registration Act and the results of it; and that without it, it would be quite impossible to approach the question of the statistics of disease, or of the general causes of death prevailing throughout the country. Whilst they spoke of minor defects, they must not be understood to be condemning the Act generally. They must also bear in mind that many of the faults complained of were not faults of the Act, but faults of the profession. He had had an opportunity some years ago of examining the death returns at an early period of such registration, and the difference between then and now was astonishing. He did not think any of them could hope to get the certificate as precise as Dr. Carpenter's observations seemed to point to; that was for the future of medicine. Dr. Vacher referred to alcohol as being seldom recorded as the cause of death. Alcohol produced its evil effects by causing disease, but he did not know that the medical attendant was always in possession of facts to show that alcohol was the cause of pneumonia or other diseases, and thus to certify it as the actual cause of death, although they had good sound ground for believing that alcohol did kill a large number of people, their knowledge was not then enough to assign alcohol as a cause of death in the same way as they might with other poisons. The zymotic causes of death were scarcely sufficiently known to form the basis of certification. As to the Coroner's Court, the object was not so much to enquire into the cause of death as they understood it medically, as to get at the cause socially. So long as the law was as it is, the Coroner's Court would be satisfied by asserting that the cause of death had been proved to be due to violence, natural causes, or otherwise, without being more specific. With regard to uncertified cases, the Officers of Health should be asked to make a personal enquiry, and to report to the Coroner; this would bring about a greater and increasing accuracy in those cases; he certainly thought they might aid the Coroner by investigating these cases. They could not hope to attain to a knowledge of the remote cause of disease, and could not blame the Coroner for this inability. The certification of deaths had rapidly improved, owing to the fact that they were overhauled by competent persons, and that this fact was generally known. Improved notification of the cause of death rests rather with the medical profession than the law; want of clearness greatly impairs the value of the certificate for the purposes of public health and scientific medicine.

Dr. J. F. J. Sykes (London) said it appeared to him that the point was to get a more accurate certification as well as a more scientific definition of disease, so that they could properly classify it. One of the difficulties was that extraordinary terms were used, and that, not in proper order. It was the custom in classifying, to select the zymotic cause first as the primary, although not so stated, then to select the constitutional, thence they passed on to the local, then to the developmental, and lastly they fell back upon the symptomatic. The

underlining process giving prominence to a particular disease or cause of death was not sufficient for him. It ought to be an orderly process which he would describe presently. He thought the suggestion that the certificate should be sent direct to the Registrar, would assist very materially in getting more correct certification. The Coroner had at present two functions, he had originally one—the social function—but now he had the medical function of defining disease, as well as the function of defining the social cause of death. These two points could very well be met by appointing a medical assessor, and in his opinion this should be done, as the medical question should not be strangled by the legal one. This brought him to the finding of Coroners' Juries. The Coroner as well as all others certifying, ought to be bound to certify apart from the verdict according to a fixed certificate. A year or so ago, he proposed before the Medical Officers of Health Society, to improve the death certificate, but the matter appeared to have been under consideration ever since. The mistakes as to the *primary* and *secondary* cause of death were very frequent, and he would suggest that the certificate should have three distinct items :—(1) "Immediate cause of death"; (2) "Proximate"; (3) "Predisposing"; and the duration of each cause. If they had a certificate of that form in which all were bound to certify, a more accurate record would result from the Coroner as well as from medical men generally. Although only ten per cent. of the deaths were uncertified, probably fifty per cent. were certified in an unsatisfactory manner, largely owing to the form of certificate, and proper certification was the basis of proper classification.

Dr. MEACHAM (Manchester) said he was a poor law officer at Manchester. He believed a great deal of truth to be suppressed in death certificates. He had had numbers of deaths against which if he had written alcohol he would have been correct, and he believed there were many deaths arising from alcohol which were in no way known so far as the death certificate was concerned.

Dr. VERNON (Southport) said that the certificates had been described as perfectly useless, as had all the statistics based upon them; but his experience was that they were completely satisfactory for administrative purposes. But as regarded classification, he sympathized strongly with Dr. Vacher, and thought the members of the medical profession were mainly, if not entirely, to blame for any difficulty that arose from these causes. A vast improvement had taken place, but as they were aware, there was still room for further advancement. It seemed to him that the less complicated a certificate was, the better it would serve its purpose; and although Dr. Sykes's suggestion was a very ingenious one, he hardly thought it was adapted to the average intellect. Elaborate details as to the sequence of systems were not wanted: what was really wanted was the *killing* disease. He was strongly in sympathy with the suggestion that the Coroner should have at his command a medical man as assessor, and that the assessor should be the Medical Officer of Health.

He thought it quite necessary too that there should be more attention paid to the qualifications of those who are selected to conduct post mortem examinations, for it appeared to him that many men engaged in the hurry and bustle of general practice were scarcely possessed of the minute and accurate chemical and pathological knowledge required by a witness at assizes.

Mr. ARMSTRONG (Newcastle) said that Dr. Vacher's paper was full and suggestive. To his mind, the criticisms in it were severe, but just, and such as every Medical Officer of Health would confirm. Feeling that the discussion that morning would be incomplete without practical action, he would propose a resolution, which, although it did not go so far as his own opinion, would, he believed, fairly embody the general sentiment of the meeting. Individually, he considered that in large towns the Medical Officer of Health was the proper person to fill the office itself of Coroner; but without prejudice, he moved the following resolution, which was a step in the right direction, viz.:—"That in the opinion of this meeting, the appointment of a registered medical practitioner, and, where practicable, the Medical Officer of Health, to the office of assessor to the Coroner, is likely to be advantageous to the public by conducing to a more accurate return of the cause of death in suspicious and uncertified cases."

Dr. J. TATHAM (Salford) seconded the resolution, and said he desired to allude to one aspect of the question which had not been previously touched upon, namely—what was to be the future position of the Medical Officer of Health in regard to it. At present when that officer devoted the whole of his time to the duties of his office, he was nothing more nor less than the Registrar of his Committee. He had not the position which a highly educated man ought to occupy. They had heard described that morning some of the duties of such an officer, but Mr. Armstrong had fully set forth in an excellent paper, what in his judgment should properly be the functions of the Medical Officer of Health. He (Dr. Tatham) would recommend those present who had not already done so, to read that paper. By virtue of his position, the Health Officer ought to be in reality the guardian of the public health, not simply a carrier out of resolutions of Committees. He ought to be the recipient of the death and sickness certificates of the medical men, and it should rest with him, to say whether inquests were necessary in certain cases, instead of with the Registrar as at present. Another serious matter had been omitted from the paper, and that was, that according to the law no registration of still births was necessary. They knew that a very large proportion of children were certified informally, on bits of paper, as having been still-born, by midwives and other ignorant persons present at birth. In the speaker's judgment, that was not a state of things that ought to be allowed.

Dr. KENYON (Chester) said he had listened with considerable impatience to the references to the office of Coroner, and the idea of

combining it with the duties of Medical Officer of Health. The existing duties of each officer were sufficiently onerous, and it was ridiculous to think that an officer could advantageously discharge the duties of both. He was particularly opposed to the Medical Officer of Health, as such, being called upon to undertake any enquiry into the causes of uncertified deaths. Such enquiry would be utterly useless, unless witnesses could be examined on oath and under formalities, *i.e.*, so far as it could be conducted by a man in the position of Medical Officer of Health. A policeman or detective might go about amongst people and collect information, which might afterwards be tested in a court of law; but a Medical Officer had quite enough to do in his own department, and he deprecated the tendency of speakers advocating the annexation of duties belonging to other departments foreign to its scope. He thought however a medical man was quite as well fitted to be a Coroner as was a lawyer; it was clearly intended to be for the purpose of making an enquiry in a common sense, rough and ready practical way for the people by one of the people.

Mr. Macassey, though neither a medical man nor a lawyer, asked permission to speak, and was allowed. He thought the view he took might be considered an impartial one. It was a fact that often the Coroner's Court was the ground for ridicule, but one reason for this was forcibly pointed out by Mr. North. The real object of the Court was to determine whether or not the death had been caused in such a way that any one was criminally responsible. Who was the best man to preside over that Court? The Jury brought in the verdict, but it was the duty of the Coroner to put the facts clearly before them. He contended that the lawyer was most suited for the office, inasmuch as he was best accustomed to weighing and dealing with evidence. The lawyer could always have competent medical witnesses, and therefore he did not see the necessity for passing that resolution nor the need that a medical man should even be the assessor. As to the classification of the causes of death, he thought the proposed simplification would be found difficult to accomplish, although Dr. Sykes had struck a keynote in giving the immediate and proximate causes of death, for by these they would see at once what was the cause of death. It was always difficult to put into simple words the multiple meanings often necessary in the classification of death causes.

The conference then adjourned. The afternoon proceedings were conducted under the presidency of Dr. Tatham, of Salford, Professor Corfield having to leave to attend the Vienna Congress.

Immediately on resuming, the following amended resolution was moved by Mr. Henry E. Armstrong (Newcastle-upon-Tyne), seconded by the Chairman, and carried unanimously:—" That the Council of

the Institute be recommended to consider the desirability of the Medical Officer of Health acting in the capacity of assessor to the Coroner in all cases of death in which there has been no medical attendant, or none from whom a certificate of death can be obtained, and that in such capacity it should be the duty of the Medical Officer of Health to make full inquiry into all cases of suspicious or uncertified death."

Dr. F. Vacher (Birkenhead) said all the gentlemen who had spoken, appearing to be in favour of the proposals made, he had not much to say in reply. With reference to the remarks he made upon the Registration of Births and Deaths Act (1874), at the time they were written, he had not expected that Lord Basing (who was instrumental in framing the Act) would be sitting by his side to hear them read. He desired to say he appreciated the value of the Act as a whole, and he wished Lord Basing were present to hear him say so; it was through this Act that the causes were duly certified in ninety per cent. of the deaths registered; but, as might have been expected, thirteen years' experience of the Act had shown its imperfections. He had been asked to say why he had not called his paper "Death causes and their *certification*"; the word "classification" appeared to be more comprehensive, especially as he was dealing with deaths certified and uncertified; it was the difficulty in classifying death causes that made careless certification a medical officer's question.

On "Provision of Fever Hospitals for Rural Districts," by G. A. Kenyon, M.B., L.R.C.P.

ABSTRACT.

Dr. Kenyon pointed out that Rural Districts vary much in character. In places surrounding large towns they were frequently of a suburban character, and on the sea coast had a large floating population of visitors. In such localities, Hospital accommodation for Infectious cases was imperatively needed, not necessarily of an expensive character, but once

established the outlay would speedily be justified by the advantages appreciated.

In purely Rural Districts, on the other hand, there is less call for Hospital accommodation, and greater difficulty in providing it. The case is sufficiently met by having available access to an Infectious Hospital within, say, ten miles; and such an Institution, where not already existing, should be established by a combination of districts within such radius.

The four-roomed cottage, which in theory should be such a ready means of isolation easily obtainable in every village, in practice is an impossibility. In a case where a sanitary authority resolved to act on this suggestion, it was discovered that the accommodation which a four-roomed cottage would afford was so incomplete compared with the relative cost of putting up a building specially arranged for Fever cases, that the latter course was adopted. A site had been presented by a benevolent landowner for such a purpose, consisting of three-quarters of an acre of land, in a suitable position. The plan adopted was that of a detached cottage for caretaker and cooking purposes; a block consisting of two rooms, each of 4000 cubic feet capacity, with nurses' room between; and behind, a shed for ambulance, washing, &c. Building materials ten years ago were considerably dearer than at present, but the whole cost of structure, furnishing, &c., was close upon £1000.

It was at first somewhat doubtful how far the Hospital would be utilized, and during the first year or two no cases were admitted. But any misgivings on this score were in time dissipated, and last year (1886) twenty-three cases were under treatment (during 1887, thirty-two); and the advantages of isolation are shown by the complete arrest of the spread of infection in the neighbourhood, which is a popular watering place, and therefore specially subject to its introduction.

The working expenses of a small Hospital are naturally disproportionately high, and with a view of diminishing these, and increasing the Hospital accommodation of the district, the need and advantages of which having been thus demonstrated, the sanitary authority have combined with four adjoining districts to erect a central Hospital. The district has been formed for this purpose under a Provisional order, which has since received the sanction of Parliament.

On "Supervision of Dairies, Cowsheds, and Milkshops," by JOHN F. J. SYKES, B.Sc., M.B., Medical Officer of Health for St. Pancras.

BY the Contagious Diseases (Animals) Act, 1878, powers were given for the control of contagious and infectious diseases of cattle and other animals, and for other purposes under general and special orders and declarations of the Privy Council, and declarations and regulations of Local Authorities, the Local Authorities in England being—for the metropolis, the Corporation of London and the Metropolitan Board of Works; for corporate towns, the Municipal Councils; for other boroughs, the Commissioners of Police; and for the counties, the Magistrates; the executive officers for enforcement of the Act being special inspectors, officers of the Local Authorities, and police officers. Section 34 of this Act empowered the Privy Council to make general and special orders in regard to cowsheds, dairies, and milkshops, and an order was so made on June 15th, 1885, superseding a previous order made in July, 1879.

By the Contagious Diseases (Animals) Act, 1886, Section 9, the powers and order of the Privy Council under Section 34 of the Act of 1878 were transferred to the Local Government Board, and the powers, regulations, and registers of the Local Authorities in the counties from the magistrates to the Sanitary Authorities; and consequently the enforcement of the provisions under the order and regulations were transferred from the police to the officers under the Public Health Act, viz., Medical Officers of Health and Sanitary Inspectors.

An amending order was issued by the Local Government Board on November 1st, 1886, after the passing of this Act, addressed to the Corporation of London, the Metropolitan Board of Works, the urban and rural Sanitary Authorities, and others concerned, setting out the transference of powers from the Privy Council to the Local Government Board, defining the local authorities, and limiting the penalty for offences to £5 and to 40*s.* a day for continuance.

The value of the change is obvious since the major part of the milk is produced in the rural districts of the counties, and has hitherto had little or no supervision at its source, where supervision is the more necessary, to prevent disease from being consigned to towns in milk cans and there distributed from house to house.

The control of diseased animals still remains under the police, who when notified communicate with the Local Authority under the principal Act, and with the Veterinary Inspector.

For details and exact wording, reference must be made to the several Acts, Orders, and Regulations, which I have laid upon the table, but to review the subject and to avoid tediousness and inordinate length, the pith of these may be briefly summarised. The Contagious Diseases (Animals) Act, 1878, Sec. 34, gives power to the Privy Council (now the Local Government Board), to make general and special orders for registering dealers in milk, inspecting cattle in dairies, and prescribing and regulating the sanitation of dairies and cow-sheds, securing cleanliness of milk-stores, shops, and vessels, prescribing precautions against infection or contamination, and authorising Local Authorities to make regulations.

The order of the Privy Council (now the Local Government Board) of June, 1885, directs milk dealers to be registered, the Local Authority to keep a register, the registration not to license buildings nor to prevent the enforcement of any Order or Regulation, the Local Authority to give public notice of requiring registration and mode of registering, makers of butter and cheese only, and persons keeping cows for private or neighbourly accommodation to be exempt, new buildings (of which one month's notice is to be given) not to be occupied unless the sanitary arrangements are to the satisfaction of the Local Authority, no building to be occupied unless the sanitary arrangements are proper for the health of the cattle, the cleanliness of the vessels, and the protection of the milk, infected persons to be excluded from contact with cows, vessels, or milk, structures liable to emit fœcal emanations to be excluded from the buildings, sleeping where milk is kept prohibited, swine to be excluded from the buildings, milk from a diseased cow to be kept separate and not to be disposed of as human food, and not as food for animals unless boiled, and clause 13 of the Order gives power to the Local Authority to make regulations for the inspection of cattle in dairies, for prescribing the sanitary arrangements and management of dairies and cowsheds, for securing cleanliness of milk stores, shops, and vessels, and for prescribing precautions against infection or contamination.

Under this clause Model Regulations have been issued by the firms of Knight, Shaw, and Haddon Best, and I believe have been approved of by the Local Government Board. The Metropolitan Board of Works possess Regulations which have been in force some years, and the Society of Medical Officers

of Health are at the present moment preparing Model Regulations. In framing Regulations, any or all of these form useful references. They vary much in detail, and the only satisfactory way of treating the subject, will be to state the main provisions and then to view in detail the points advisable for the protection of milk, leaving questions of limitation of the individual bye-laws to the decision of the Local Government Board, and bearing in mind that the more the Regulations of any particular Sanitary Authority enter into detail, the less discretion is left to the Medical Officer and Sanitary Inspector, and *vice versa*.

The Regulations made under the Orders, and the Orders made under the Acts, it is to be presumed are all to be read together as far as compatible, and it is therefore advisable for Medical Officers to be familiar with the Acts; and the Orders and Regulations may with advantage be printed together.

Sec. 9, sub-sec. 4, of the Act of 1886 should be carefully read, it concerns the power of entry, and indirectly points to the officers. The Local Authority and their officers are thereby given the power of entry under the well known Sec. 102, of the Public Health Act, 1875; but there are no powers there or elsewhere to appoint special officers to carry out these orders and regulations. Although Knight's bye-laws speak of any other officer specially authorized by the Sanitary Authority, it would be any other officer of the Sanitary Authority specially authorized, a different construction; so that the duties fall upon the Medical Officer of Health and the Sanitary Inspector, without any apparent necessity for special appointment, and sub-section 4 gives them the power of entry. But a provision is added to this sub-section by which in a declared infected district they are excluded from any cowshed or other place in which an animal affected by disease is kept, except by permission of the Local Authority under the principal Act, *i.e.*, in the counties, the magistrates.

The main provisions of the model regulations include, as to cowsheds and dairies:—

Inspection.—The Medical Officer of Health, Sanitary Inspector, or other officer, having obtained access, is not to be obstructed nor refused assistance.

Lighting and ventilation to be sufficient and proper.

Air-space for cows not to be below a certain limit.

Cleansing as often as necessary.

Drainage to be effectual, the inlet to the drain to be outside the shed or building.

Water supply to be of good quality and sufficient in quantity.

Milkstore or shop to be cleansed as often as necessary.

Milk-vessels to be cleansed with hot water or steam immediately after use, or after being returned, and to be kept clean when not in use.

Infection or contamination of milk to be provided against by avoiding the storage of milk in a room or place exposed to foul emanations or to risks of infectious disease, and by properly disinfecting and cleansing vessels used by an infected person or at an infected house.

As milk is the most perfect, and at the same time the most perishable food we possess: when pure, most beneficial in sustaining vitality, and under adverse circumstances equally powerful in injuring health: the object of supervision should be so directed as to prevent contamination, and at the same time to avoid hampering production.

The opportunities for contamination are numerous—in milking, in conveyance to depôt, in transit by rail and road, or in delivery. Previously to reaching the consumer it may take place in the fields, the cowshed, the dairy, or the milkshop.

The sources of contamination may be man, the premises and utensils, or cows and other animals.

Man, from the drawing of the milk until its consumption, is more or less in constant contact with it. It is probable that most of the infectious diseases of man can be readily propagated in milk and invade the consumer. And it has not been denied that the principal zymotic diseases can in this way be spread. We have accumulated evidence of the spread of scarlet fever, diphtheria, and typhoid fever. The infection of small-pox, diphtheria, scarlet fever, typhus, typhoid fever, and cholera, are to be specially provided against. For like the seed in the parable of the sower, micro-organisms falling into the cultivating fluid, milk, fall upon "good ground" and there produce more than a hundred-fold.

A general Act requiring the notification of infectious disease, and isolation where necessary, would prove more efficacious than the present piecemeal legislation in preventing the infection not only of milk but of all surroundings to which milk is more or less always exposed. For instance, employés hailing from tenemented houses, purchasers and visitors in the ordinary course of business, and so on.

The ways in which milk may become infected are so multifarious, that nothing short of general notification is of any effectual avail, and the protection afforded by special Orders and Regulations can only be imperfect.

Under any circumstances a dealer in milk should be required to notify to the Medical Officer of Health, the outbreak of

infectious disease on his premises or amongst his employés (if it come to his knowledge) and to remove all milk and utensils from the infected premises, and to cease selling milk until the premises have been disinfected and pronounced free from infection. Unfortunately this does not reach the employés themselves. No milk or utensils should be stored or kept in a sleeping apartment, and no place where milk utensils are stored or kept should be slept in. No utensils from the house of or used by an infected person should be used again until properly cleansed and disinfected.

Premises and Utensils in their structural condition and management can be controlled more easily and more effectually than disease in man or animals, and they form the most satisfactory subject to deal with in regulations.

As to Cowsheds.

The Lighting should be sufficient to light every part of the shed, because light is indispensable to perfect health, and because where there is darkness there is usually dirt; but it should not be excessive, or the cooling effect of large window surfaces results in the blocking of ventilators to maintain the temperature in cold weather. Cows require a temperature variously stated at from 50° to 60° F., and produce most milk at the higher temperature.

Ventilation may be provided in a simple but effectual manner by means of a louvred lantern or other ridge ventilator at the apex of the roof, assisted by hinged windows with louvred sash in the walls about two-thirds of the distance up from the floor of the shed. There must necessarily be an inlet and an outlet under this arrangement, but those who have dealt with inlets and outlets know how impossible it is to decide which will be which; but by watching the wind currents, and by regulating the windows and doors accordingly, the ventilation may be fairly controlled. The ventilation in winter requires gentle handling; it must be remembered that cowsheds are either constructed of wood or brick, or both, and the walls are usually exposed; therefore a considerable change of air naturally takes place through the walls, and the lower the temperature, the greater the change. Consequently it is impossible to fix a size for ventilators, without a knowledge of each particular shed. Very little experience is necesary to judge of the sufficiency of ventilation, and therefore of the size and position of the ventilators. Unfortunately the organic matter does not diffuse equally well, but accumulates; in order to discharge the organic matter, the doors and windows might be thrown open for a short interval once or twice a day, to flush the shed with air.

Air-space.—The Local Government Board have advised the

adoption of not less than 800 cubic feet for each cow. This means a lair of 4 ft. by 8 ft., a gangway of 4 ft. by 4 ft., and a height of 16 ft. plus a small addition of the roof space, for each cow.

Water-supply.—The water should be of good quality, and Section 70 of the Public Health Act, 1875, gives power to close a polluted well, tank, cistern, or pump. The quantity to be provided will include both water for drinking and for cleansing purposes, and the amount required for cleansing will be considerable. It would not be unreasonable to place the amount at half what is usually considered requisite per head for human beings—say 15 gallons.

Cisterns may or may not be necessary, according to whether the supply is constant or intermittent. They should be placed outside the shed, the bottoms at least six feet from the ground, and the overflows discharging into the open. For drinking and feeding purposes *troughs* are preferable to buckets and mangers. In new buildings they should be provided and furnished with a hard smooth impervious lining.

Food-supply.—*Fermented* food should be kept in proper receptacles, not within the buildings, and the receptacles should be periodically cleansed.

Drainage should be effected by the floor surface of the stalls made impervious and with a fall towards the gangway, the gangways being also impervious and with a fall towards the drain inlet, which should be situated outside the building, protected by a grating and properly trapped. Sometimes a drain is constructed under the gangway, in which case it should be disconnected from the drain or sewer outside the building by air and water.

Refuse matters should have drained receptacles provided for them in the open, and be regularly emptied and cleansed. Sunken receptacles or pits for cowshed or stable refuse are always objectionable, the drainage becoming blocked by overlying material converts them into cesspools. The floor of such receptacles should form part of, or be level with, the surface, and drainage should be effected by openings in the sides at ground level.

Cleansing.—The interior, including the walls, roof, and woodwork, should be cleansed at least twice a year; the front six feet up, and sides of the lairs, once a week; the floor, the trough or mangers, and the lairs, thoroughly cleaned out and flushed once a day; and between each milking the gangway should be swept down to remove all liquid filth and dung. Cleansing here meaning scraping, limewhiting, painting, or washing, according to the requirement of the surface.

Utensils should be washed after use, first with cold water and then with hot water or steam. It would be useful prevision to restrict receptacles for milk to tin, glass, and porcelain. All cisterns, troughs, pits, bins, and other receptacles and apparatus should be kept in a cleanly condition.

Contamination.—Closets, privies, cesspools, urinals, openings of drains, receptacles for dung, for fermented food, &c., should be excluded from the buildings.

New Buildings.—The "reasonable satisfaction" of the Local Authority, mentioned in clause 7 of the Order of 1885, might include some advance on the "prescribing and regulating," mentioned in clause 13 for old buildings.

Milking.—A useful precaution would be to supply proper convenience for washing the milker's hands and the udders previous to milking. Unfortunately another difficulty arises in the collection of the milk. The milk from various cows is mixed to equalize the quality; milking sick animals is beneficial to their recovery, and milk from cows slightly disturbed in health disturbs the health of man, a logical series of premises of which the conclusion is not difficult to arrive at, although the milk of a diseased cow is prohibited from being mixed with other milk.

As to Dairies.—Many of the requisites for cowsheds also apply to dairies.

The lighting should be sufficient to enable the operations therein to be easily conducted and to see that cleanliness is scrupulously maintained. The window surface may be as great as possible since coolness is requisite for a dairy, and for the same reason direct sunlight is not desirable. So that it is the position rather than the size of windows that should be considered here.

Ventilation also should be copious and without restriction, fixed louvred ventilators, air bricks and other permanent open ventilators are requisite.

Water supply as in cowsheds should be pure and abundant.

Drainage.—The floor of a dairy is best paved or covered entirely with a hard smooth impervious surface laid with a fall as in cowsheds, and waste pipes should discharge into the open.

Cleansing resolves itself into painting when and where necessary, limewhiting and washing the walls, ceiling and woodwork at least twice a year, washing the fixtures at least every week and cleansing the separating, cooling, washing, and other apparatus, utensils and vessels after use, and the vessels when returned, and keeping all clean when not in use. The cleansing of vessels is best accomplished by washing them first with cold water and then with hot; this is readily done, but the most

complete cleansing is effected lastly by steaming the vessels. The steam acts as a disinfectant, cleanses well, and by its latent heat dries the vessels rapidly. Steam apparatus in a dairy is of great value.

Contamination is to be avoided by admitting only air from pure sources, and as in the case of cowsheds excluding all structures that may become possible sources of impurity. All decomposable organic matters except milk should be rigidly excluded.

New buildings.—In them it might be advantageously provided that the dairy should be used only for the storage and treatment of milk, and that fixtures, apparatus and utensils for that purpose only should be admitted.

The remarks as to lavatory arrangements apply also here.

WHEN WE TURN TO MILKSHOPS, the control is much less satisfactory, especially of miscellaneous shops where milk is sold. The regular cleansing of the fixtures and utensils, and prohibiting them from other uses than the storage of milk, and the periodical cleansing of the shop can be required. But beyond that we must fall back upon the Public Health and other Acts for the sanitary condition of the premises, and it is here that we feel acutely the necessity for the general notification of infectious disease. How much disease is spread by small milkshops selling also other foods and miscellaneous articles, it is difficult to ascertain, and probably we shall never know; it can only be inferred by analogous experiences. Shops that retail only small quantities of milk usually either return the utensils dirty to the milk-dealer, or the utensil is retained to be filled daily by the milk-carrier and only cleaned to prevent souring.

The Order only permits the regulations to deal with the shops and vessels, but it would be very desirable to place restrictions upon the registration of milkshops which should extend beyond these. For instance, there are shops used as thoroughfares for all the occupants of a tenemented house, shops only separated by an apology from sleeping rooms, and shops that sell objectionable miscellaneous articles. It might with advantage be conditional that only foods should be sold in a milkshop.

Under the Order there is no power to refuse registration, except to new buildings, but the Authority must register the dealer whatever action it may take afterwards, and non-registration is illegal. Itinerant vendors possess an opportunity for evasion which must not be overlooked.

The tendency is for large organisations to replace the ordinary milk retailer in the delivery of milk, but the small retailer in squalid neighbourhoods remains unaffected, and that

is a difficult point to handle, while at the same time to avoid interfering with the food of the poor.

As to Cows themselves and other Animals.—The water and food supply of milch cows in pasture is important. The pasture can be protected in some measure under the head of abatement of nuisances, by the cleansing of foul ditches and ponds of stagnant water, and by the removal and prevention of the deposition of noxious refuse, etc.

In sheds, besides good structural condition and management, certain other precautions are advisable. The exclusion of swine is imperative; but whatever may take place in pasture, other animals, especially the carnivorous, are not fit permanent residents in a cowshed, however harmless they may be, temporarily. Quarantine for a reasonable time of newly-arrived animals, is a course which a wise keeper of cows would adopt. The isolation of sick cows, even for the lesser ailments, would be an advantage; under any circumstances it is always in the power of the Medical Officer and Sanitary Inspector to report to the police for the attention of the Veterinary Inspector.

The tendency of the large organizations is not to produce their own milk, but to receive their supplies from independent farmers; and in the latter case, usually no Veterinary Surgeon is retained, as would be probable in the former.

The duties of supervision might be conveniently sub-divided. The clerk to the Sanitary Authority keeping the register, the routine work of the orders and regulations being carried out by the Sanitary Inspector regularly and constantly, and seeking the advice of the Medical Officer in cases of irregularity.

The control of infectious disease in man falls naturally to the Medical Officer of Health, and he should be acquainted with new premises and premises of newly registered milk purveyors.

The control of infectious disease in animals falls to the charge of the police and the Veterinary Inspector, to the former of whom notice would be given. But it would certainly be a power if the Medical Officer could recognize when a cow was in good or bad health, and this seems almost to be inferred in the order by placing the inspection of cows in dairies under the Sanitary Authorities. The infectious "disease," falling to the province of the Veterinary Inspector of a Local Authority appears to be restricted to cattle plague, pleuro-pneumonia, and foot and mouth disease, although Secs. 29 and 32, of the 1878 Act, and Secs. 6 and 8, of the 1886 Act, give the *Privy Council* power over other diseases. As sanitarians we are not justified in restricting the term infectious in any way, for it

still remains to be shown what diseases of the cow and of other animals are, and what are not, communicable to man and to other animals; and whether they are not communicable in a mild and almost unrecognizable form equally as well as when pronounced.

Veterinary Surgeons do not favour ordinary cow practice. When seeking information upon the subject of cows, I was kindly informed by Professor Robertson of the Royal Veterinary College, that although the diseases of cows are taught theoretically, the difficulties in the way of obtaining animals for demonstration were so great, as to preclude practical instruction at the College. So that with his knowledge of medicine a Medical Officer of Health with a work of reference and a sick cow, should be able to form as good an opinion as a Veterinary Surgeon, and with a little observation perhaps a better one. Medicinal treatment is not included in this suggestion but purely diagnosis. The field for the researches of medicine in the influence of the health of animals upon man remains an open and a fertile one.

Dr. J. Tatham (Salford) said there could not be two opinions as to the intrinsic value of the paper. The subject dealt with was one bristling with difficulties, and he should be disappointed if an important discussion did not arise upon it.

Dr. F. M. Corner (Poplar) said a paper like this should not be allowed to lie dead until the printing of the Transactions, as to every Medical Officer of Health and every Inspector of Nuisances it would be of extreme value. One means, not noticed, by which milk could become contaminated, was from the possibility of infection from venereal sources. Cleansing of the udders and the hands of the milkers was extremely rarely attended to. If the straining of the milk were attended to, they would find that there was regularly a quantity of dry excreta being transmitted to the milk from the udders, and that this was carried to the different houses. It could be shown that there was great carelessness in the grooming, very little attention in fact being given in the common dairies of London to getting the udders cleanly.

Mr. S. W. North (York) said there could not be two opinions about the obligation the Conference was under to Dr. Sykes for his admirable paper. Coming from an urban district, he was painfully conscious how impossible it was to deal with the great proportion of the milk-sellers of the poorer class under existing regulations: sometimes it was stored in greengrocers' shops, and he had seen it stored in closets adjoining privies. These were conditions it was extremely difficult to prevent under the present regulations; but he thought before long they would have larger and ampler powers than those now in force;

and that one of the very first powers that would have to be conferred upon the Medical Officer of Health would be that of visiting the sources of the milk supply, wherever they might be. That power might even now be obtained by any authority seeking an Improvement Act. A much simpler and more complete plan would be that no milk should be sold within any sanitary area except by licensed milk-sellers, and that these sellers should have a documentary license from the authorities, which should imply that their premises were suitable; that they should be prepared to supply lists of their customers, and to disclose the source from which the milk was obtained, *i.e.*, the farm or other milk purveyor. If that were done, it would be quite possible for Medical Officers to trace the origin of some of the diseases due to infected milk better than they were able to do now. He had this brought forcibly before him last year by an outbreak of typhoid fever he had to investigate. A large number of cases arose with great rapidity. After a time the milk supply was suspected. He obtained a list of the consumers from the small retail dealers, who bought the milk of a farmer and sold it second-hand; he ascertained that nearly all the people obtaining their milk from this one source were down with fever. The particular man who supplied it to the retail dealers resided beyond the boundary of his authority, and he sold it to three persons who sold it again. 120 cases were brought into relation with this single milk supply. At ten o'clock at night he went to the residence of the farmer and insisted on seeing his family. He found three cases of typhoid fever in the house. The medical man in attendance said he had some doubt as to the nature of the disease, hence the present visit. He went into the yard and found that the milk vessels were kept close to the privy, which was near the well; that the place was very dirty. He obtained possession of some of the milk, and found that it was diluted with ten per cent. of added water. All this action was irregular, if not illegal; but he did it, and he did something more. A large portion of this milk was sold by a dairy company, who gave him a list of their customers. He told the master that he was spreading typhoid fever, and that he must stop it; his managing director, who lived fifty miles away, wanted to know by what authority he had taken the course he had, remarking that he would consult his lawyer; he replied that he had no legal authority for what he had done, but at once informed him that if he did not immediately stop the sale, he would write to the newspapers saying that he was selling poisoned milk, or otherwise advertise the fact. They might be sure that no proceedings were taken against him. It was wrong, however, with the knowledge they had of how disease could be spread by infected milk, that he should have had to take these irregular methods and subject himself to possible trouble. Medical Officers ought never to rest satisfied until they were in a position to direct that no milk should be sold except from premises in a good sanitary condition, and to compel milk-sellers to state the sources of their supply, and themselves have the right to visit and inspect them. This power, as he had said before, could now to some extent be obtained under Mr. Sclater Booth's clauses, which had recently been extended.

Dr. E. W. Hope (Liverpool) asked Dr. Sykes' experience as to tuberculosis in cows. Was it prejudicial to the consumers of the milk from those cows? Dr. Sykes would of course be aware that the early tuberculosis was exceedingly difficult to ascertain, and that it was moreover very common. Many cows taken from the shippens for slaughter were affected with tuberculosis to a very marked extent. He had gone to the pens and taken the temperature of large numbers of cows, and the temperature of those confined in the shippens ran to 103° or 105°. The temperature of cows was always above that of other mammals, human beings for example. As to the necessity for some system of compulsory notification of infectious disease occurring in milkshops, there could be no two opinions. Over and over again he found out the existence of scarlet fever in cowsheds or milkshops where children were lying ill upstairs, and the mother in attendance in the sick room, which she would leave to serve customers. Thus it appeared to him absolutely essential that some system of compulsory notification should be made to apply to milk places. They had regulations in the city of Liverpool with reference to licenses for the sale of milk, but as Dr. Sykes said, the making of absolute regulations was exceedingly difficult; a certain latitude must be left for the Medical Officers and Inspectors to work in.

Dr. Mason (Hull) said the paper showed how imperfectly the order worked, and he did not know of anything more difficult than the administration of it. It was not an occupation with as it were an apprenticeship, and it was remarkably difficult to supervise the cowshed of a person who had not the slightest knowledge of keeping the animals. Both Medical Officers and Inspectors should have a special knowledge of the diseases of animals. In his experience, it was not in the premises of the large purveyors of milk that the disease took place; as a rule, it generally arose on the premises of the small dealer, and these should be carefully watched.

Dr. J. Tatham (Salford) said he quite agreed with the observation that it was seldom in the establishments of large purveyors of milk that disease originated, but generally in the premises of the pettifogging milk-sellers, where they found milk stored in the same small apartment with paraffin oil, red herrings, and so forth; the room being, in some cases, separated by a mere partition from a child suffering from scarlet fever. No doubt disease was frequently spread in that way. In Salford they had one large firm of milk purveyors who adopted a good plan to ascertain whether the milk supply was free from infection. This was an enterprising and a prosperous firm, who made arrangements with the Medical Officer of Health of a large rural district to supply them with information regarding every case of human infectious disease which he knew to exist on the premises of the milk producers concerned. By this means the purveyors made pretty sure that they were not importing amongst their customers milk poisoned with fever germs. This precaution might very well be extended, in the interests even of the purveyors, for it gave their

customers confidence, and accordingly tended to enhance the success of their business. He thought the Medical Officer of Health was paid a guinea for each report: a very handsome payment, they must admit.

Dr. J. F. J. Sykes (London), replying to the discussion, thought the Chairman's remark as to the arrangement with the milk purveyor was a reasonable one; for although every one might notify to the Medical Officer of Health, the milk dealer might be ignorant of disease amongst his employés; he thought that if it were known it would be more generally adopted. Dr. Corner touched on venereal disease. That was one of the points that would be observed by the Medical Officer of Health in the dairy or cowshed: he should not omit to observe the milkers. Dr. North laid stress on the question as touching the poorer classes, and thought there should be some control of the registration of milkshops. The *premises* ought to be registered, and they should be able to trace the milk from its origin to its final consumption. As to tuberculus disease, he did not wish to enter upon the details of communicable diseases. Whatever disease the animal had, they would find it in one or other of the excreta, and, whether directly or indirectly, it would find its way into the milk. Dr. Hope raised the question of compulsory notification. He should very much like to know the opinion of the Local Government Board upon this question, as raised in the Metropolitan regulations. The Metropolitan Board of Works had compulsory notification, or what they required in their regulations virtually amounted to it. The words in the regulations were: "Every purveyor of milk, or person selling milk by retail, shall, immediately on outbreak of contagious or infectious disease in the house or amongst the persons employed, give notice." The next clause stipulated that every purveyor of milk, &c., shall remove all milk for sale and all utensils, until the same shall have been disinfected and declared by the Medical Officer free from infection. The Medical Officers asked how they were to know it, so long as the notice was sent to the Metropolitan Board of Works, instead of to the District Board. The Metropolitan Board thereupon undertook to notify the Medical Officer. But the other regulations to which he had alluded were unsatisfactory in regard to compulsory notification, no such power being given under the Order. Dr. Mason tried to obtain an opinion on the communicability of disease, but he did not wish to enter into that question. He could not go so far as Dr. Mason, and say that a medical man should be a cow-doctor. What he would say was, that in medicine the first step was to know what health consisted in and what should be its appearance. It was sufficient at present to know that a cow was healthy. Before they could reasonably expect to protect milk, they must have compulsory notification; the next step being licensing of premises where milk is kept. These were the two points.

On "*The Port Sanitary Authority, Liverpool, and its work,*" *by* J. STOPFORD TAYLOR, M.D.

UNDER the provisions of section 287 of the Public Health Act, 1875, the Corporation of Liverpool have been appointed the Sanitary Authority for the Port of Liverpool, which "commences at the termination of the Port of Chester, namely, at the Red Stones in Hoylake on the point of Wirral, and continues up the River Mersey to Ince Ferry inclusive, being the eastern termination on the Cheshire shore of the Port of Runcorn; thence crossing the River Mersey in a straight line to Dungeon Point, being the western extremity on the Lancashire shore of the said Port of Runcorn; and continues along the coast of the County of Lancashire to a gutter or river of water, commonly called the Hundred-end water, on the south side of the River Ribble, being the southern boundary of the Port of Preston, and shall include all rivers, bays, channels, roads, bars, strands, harbours, havens, streams and creeks within the said limits contained, and shall extend seawards to a distance of three miles from low-water mark along the coast within the aforesaid limit." This is a most extensive area to supervise, but fortunately with the exception of fishing boats at Hoylake and Southport, all vessels have to enter the Mersey to reach the Liverpool, Birkenhead and Garston Docks, so that should there be infectious disease on board any ship information can at once be conveyed to the Medical Officer of Health. To facilitate the working of the order the Corporation of Liverpool have delegated to the Birkenhead Corporation their powers, rights and duties over the Birkenhead Docks and the vessels lying in them.

There is, however, unfortunately, a dual medical authority at the Port of Liverpool, for besides the Medical Officer of Health there is a Medical Officer appointed by the Customs under the old Quarantine Act of George III., which is re-enacted by the Public Health Act of 1875, and states further that "Every vessel having on board any person affected with a dangerous or infectious disorder shall be deemed to be within the provisions of the Act of the sixth year of King George the Fourth, chapter seventy-eight, although such vessel has not commenced her voyage, or has come from, or is bound for some place in the United Kingdom." Excluding the management of cholera ships, which are placed under the control of the Medical Officer of Health by a special order of the Local Government Board,

all other infected ships are to be visited by the Customs Medical Officer, and are liable to quarantine. By the 39 and 40 Victoria c. 36 s. 234, the Privy Council may from time to time require that no person shall land from a ship coming from a place infected with yellow fever or other infectious disease, until the officers of the Customs have examined into the state of health of the persons on board and given permission to land, any person being liable to a penalty of £100 for disobedience. These powers of the Customs, acting under the authority of the Privy Council, are in a measure antagonistic and opposed to the satisfactory working of the Port Sanitary Authority. Section 110 of the Public Health Act, 1875, states that, "For the purpose of the provisions of this Act relating to nuisances, any ship or vessel lying in any river, harbour, or other water within the district of a local authority shall be subject to the jurisdiction of that authority in the same manner as if it were a house within such district." Section 124 states, "where any suitable hospital or place for the reception of the sick is provided within the district of a local authority, or within a convenient distance of such district, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, or is on board any ship or vessel, may on certificate signed by a legally qualified medical practitioner, and with the consent of the superintending body of such hospital or place be removed, by order of any Justice, to such hospital or place, at the cost of the local authority." By section 125, "Any local authority may make such regulations (to be approved by the Local Government Board) for removing to any hospital to which such authority is entitled to remove patients, and for keeping in such hospital so long as may be necessary, any persons brought within their district by any ship or boat who are infected with a dangerous infectious disorder."

It will thus be seen that the local authority has given to it, by the Public Health Act, every power necessary for the inspection, examination, and disinfection of ships, as well as the removal to hospital of infected persons; and further, I may state, the local authority is fully provided with the means and appliances requisite for the proper performance of the duties. Whereas, the Customs officer pays a visit to an infected ship, signs some official documents, and takes his departure. That is all he can do unless he places the ship in quarantine, which is only done when the vessel is infected, or supposed to be infected with yellow fever, and even then application has to be made to the Medical Officer of Health for assistance before she can be released. It is quite time that the Quarantine Act

was altogether abolished, as its powers are useless for any good purpose, and are capable of much mischief by retarding commerce and delaying efficient sanitary supervision.

It may possibly be of some advantage for the Privy Council to retain, through the Customs, some kind of authority over infected ships, but it is difficult to discern their object when, as occurred a few years ago, a large steamship, having many passengers and a large cargo, was quarantined for five days, without having a single case of sickness on board, simply because she had come from a port infected with yellow fever, and had lost three or four persons during the voyage. Surely, if they wished to have an outbreak of the disease, they could not have adopted more likely measures than isolating both passengers and crew on ship board and cutting them off from all outside communication. This course might be followed by Spain and Italy where yellow fever occasionally spreads, but in Liverpool, where the disease never comes and is entirely unknown, it is perfectly absurd. If the Privy Council have reason to believe that yellow fever might be introduced, let them make an order somewhat similar to the cholera order of the Local Government Board, and let sanitary supervision, not obsolete quarantine, be their instruction.

The Port Sanitary Authority has a hospital situated at New Ferry, Cheshire, capable of accommodating twenty-four patients, with sufficient land for tents or sheds, if required, for two or three hundred persons. This hospital has been used for cholera patients only, all cases of the other infectious diseases are removed to hospitals in the city. For the purpose of removal the ambulances and staff of the city are utilised, as well as for the disinfection of ships, and thus a considerable saving is effected by an arrangement with the Health Committee, that the Medical Officer of Health may use any carriage, men, or material belonging to them, instead of keeping a separate establishment, which could only be done at a considerable cost.

Vessels are not quarantined for small-pox, typhus, typhoid, scarlet and malarial fevers. The patients are removed to hospital and the ships disinfected; in fact a vessel is treated in every way as a dwelling-house, the cabins (occupied by the sick and the attendants) are fumigated with sulphur and then well ventilated and cleansed down. The large steamship companies knock down the cabins and burn them, with the beds and fittings, to avoid any risk of contagion being left on board.

When a vessel arrives in the Mersey having, or having had, cholera on board, the Customs authority, in accordance with the cholera order of the Local Government Board, immediately communicates the fact to the Medical Officer

of Health, and detains the ship for his inspection. The medical officer then boards the ship, inquires as to the amount and character of sickness since leaving the last port, examines the sick people as well as the crew and passengers, and if satisfied that the ship is infected, a certificate to that effect is given to the master, who then moves the vessel to the Sloyne, being that part of the river agreed upon for mooring infected vessels. All persons who are well, and not required for the management of the ship, are allowed to land, a record being kept of their addresses. The sick, if able, or as soon as able, are removed to hospital, and the ship thoroughly disinfected and cleansed. In the case of cholera ships which arrived in Liverpool in 1884, every part of them was fumigated with sulphur, the bedding and clothing being freely exposed to the vapours. Carbolic acid was mixed with the water in the tanks and bilges, and then pumped into the river at ebb tide. Most of the bedding and clothing of the sick were burned, the remainder were taken to the disinfecting stoves and submitted to a high temperature for eight hours. All the refuse of the ships, including the ashes from the boiler fires, and the dirt from the bilges, was put on board the Corporation steam hoppers and taken thirty miles out to sea, where it was discharged. As a result of these precautionary measures the disease was stayed, and there were no fresh cases.

For the purpose of carrying out the Sections of the Public Health Act, 91 to 111, relating to inspections and nuisances on shipboard, it is necessary to have an inspector who is as conversant with the construction, management, and condition of vessels as an ordinary inspector of nuisances is with dwelling houses, otherwise he would not be able to report as to the wholesome condition of ships, with reference to ventilation, water storage, bilges, closets, and the condition of the quarters of the crew as to ventilation, lighting, dampness, cleanliness, &c. The Liverpool Port Sanitary Authority have been fortunate in securing the services, as inspector, of Mr. J. J. Brown, who holds the certificate of master, and has been in command of large steamers and sailing ships. Single handed he does a large amount of work in visiting ships, superintending the removal of sick persons, and the disinfection of vessels. Last year he inspected 4,120 vessels, of which 3,844 were found in fair or good sanitary condition, and 276 defective. In 105 the forecastles, peaks, deck-houses, or cabins required cleansing, and painting or lime-washing, and in some of them the forecastle scuttle-doors wanted repairing or renewing. In 12 the bulkheads were faulty, in 91 defective ventilators, in 50 imperfect closets, and in 18 the deck over the quarters occupied by the crews required caulking. It is

a pleasing fact to state that since the appointment of the authority it has not been necessary to take legal proceedings in a single case, the owners or managers being willing to comply with all requirements, and consequently there is a great improvement in all classes of vessels.

The Mersey partakes more of the character of an estuary than a river, and is frequently so crowded with shipping that it would be difficult to appoint a boarding station, as on the Thames or Tyne, for the inspection of all vessels entering the port. Besides it would never do to detain a large steamer without good reason and cause her to lose a tide in docking, as it would entail not only delay but might inflict a considerable loss on the owners. We must trust to the intelligence and honesty of ship masters to give true reports to the Customs officers of the health of their crews and passengers, for it is to their interest that the ships should be freed from infection, otherwise they might have to suffer from the rigorous quarantine of foreign countries. The rapidity with which steamers cross the Atlantic permits the introduction of some infectious diseases during the period of incubation; the disease not being manifested until after the passengers have landed. Many instances of this have occurred, notably where people have landed apparently well and subsequently developed small-pox. This risk must be met by our second line of defence, the good sanitary condition of our towns and cities.

In conclusion, perhaps I might suggest the desirability of ship surgeons being brought into direct communication with the Medical Officer of Health, and that they should submit to that officer full reports of the health of the ships during the outward and homeward passages. This would be an advantage to the officers themselves, as they would thus obtain official recognition of their position and have the support of the Sanitary Authority.

Dr. Mason (Hull) opened the discussion on Dr. Taylor's paper. He said he represented the third port of the kingdom, and should like briefly to allude to the questions introduced into the paper, as to dual control and the inspection of ships. In the port of Hull they had no such thing as a Customs Medical Officer: the control was in the hands of the Port Sanitary Medical Officer at Hull. In listening to Dr. Taylor's paper it appeared to him that at Liverpool they had two antagonistic officers; his experience as to not finding it necessary to resort to legal proceedings to enforce orders on ships, entirely agreed with his own. Their Port Sanitary regulations were developing,

inasmuch as they had recently obtained a provisional order from the Local Government Board, extending their powers in a most important degree. The action of the Local Government Board in this matter, showed the importance they attached to the maintenance of the public health, and to the prevention of the inroads of various diseases through importation. As to the importation of yellow fever he was particularly interested, having recently had an experience of it. The measures taken were these: the Customs immediately on the arrival of the ship notified the illness; the vessel was immediately inspected by the Medical Officer of Health, the persons affected removed to the hospital, and the ship disinfected and released. The question of quarantine was not entertained. Some suggestions had been made with reference to the whole question of quarantine. It had been mentioned by Prof. Corfield that a conference was to be held in London, and it was suggested that those having the jurisdiction of Port Sanitary Authorities in England should be represented strongly so as to urge the best means of dealing with infectious diseases imported into the country. He must say that those who had to administer public health in connection with their shipping, should be well selected. The duties were not learned in a few days; they were only gained by years of experience, and it was highly essential that in these appointments the selection should fall on experienced men. If the duties were thoroughly understood and properly carried out, little difficulty would be experienced in complying with the various Acts of Parliament. As Dr. Taylor suggested, he thought each ship carrying passengers and emigrants should contain a surgeon, part of whose duty it should be to report to the Medical Officer of Health what sickness there had been during the voyage. Suspicious cases should not be allowed to pass unnoticed, and hospital accommodation should be provided for infectious diseases. In Hull, it was one of their systems of inspection that after a suspicious case had been removed for isolation, the ship was visited daily, whilst in the port, by an experienced inspector, with a view to ascertain if any further illness occurred. He sincerely hoped the question of quarantine would not be lost sight of, but would be considered by the International Congress when it met in London; it was important from a medical as well as a commercial point of view.

Dr. J. F. J. Sykes (London) regarded it as an absolute necessity to settle this question of quarantine, concerning as it did not only preventive medicine but also the whole commerce of the country. It was a trader's as well as a Medical Officer's question, and he trusted that at the International Medical Congress the medical profession would muster very strongly and fight the battle of inspection and isolation against the quarantine system. It was necessary to convince Europe that the quarantine system was fallacious, and was breaking down wherever it was established. The eyes of the foreigner were being opened to the fact that the isolation system was not purely a mercenary one. He believed they would be able to prove to the foreigner's satisfaction that the fundamental basis was sanitary. It

was a question of world-wide import, and every opportunity should be seized to press it home.

Dr. J. F. Tatham (Salford) added his testimony as to the cardinal importance of the matter brought under notice. He regarded it as nothing less than a national calamity that the International Congress of two years ago, despite the weighty evidence of Dr. Thorne, H.M. Inspector under the Local Government Board, found it impossible to convince the representatives of foreign powers that inspection was the right, and quarantine the wrong thing. Every effort ought to be made, at the forthcoming Congress on British soil, to convince the foreign delegates of the desirability of substituting the British scientific principle of medical inspection and isolation of individual sick cases, for the absurd and vexatious system of mere quarantine, which now prevailed in so many foreign countries.

Dr. E. W. Hope (Liverpool), in replying for Dr. Stopford Taylor, thought every one must be agreed as to the immense superiority of medical inspection of vessels over quarantine. In dealing with every other form of disease, they found medical inspection to answer perfectly well, and there had been no reason to question its efficacy in the case of cholera. In Liverpool they had a fairly good notice, as a rule, of approaching disease, whether cholera or anything else. Persons were removed to hospital when thought necessary, and the ship thoroughly disinfected and cleansed. In regard to dealing with small-pox, the plan in vogue is this: the vessel is boarded in the first instance by the Customs Authorities, and if sickness were found on board they notified the fact to the Health Department; the officers of this department visited the vessel, and removed the patient to hospital and disinfected the ship. In regard to the dual control, disapproved of by Dr. Taylor, the position of the Quarantine Medical Officer was rather curious, because if he visited he could merely certify the nature of the illness to the Sanitary Authority, or their Medical Officer, and had no further powers. Dr. Taylor referred to the importance of having a master mariner to occupy the position of Inspector of Ships. This was a matter absolutely essential, because it took years to gain the requisite knowledge of ships and shipping to say whether a vessel was in a sanitary condition or not. In their case the appointment of a master mariner had been favourably spoken of, and it was likely others would in time follow the same plan. An immense number of emigrants came through from Hull, London or Newcastle, the average for four or five years having been about 150,000. If sickness broke out, they detained a batch when necessary, rather than incur risk of further outbreak.

Mr. S. W. North (York) at this stage asked permission to propose a resolution; it was as follows: "That this meeting wishes to direct the attention of the Council of the Sanitary Institute to the desirability of rendering the Conference of Medical Officers of Health (held for the first time at York) a permanent feature of the Annual Con-

gress of the Sanitary Institute." He had been exceedingly gratified with the two Conferences they had held, and should be pleased to see them made a regular feature. On the subject of quarantine he thought it would be well if the Council could propose some scheme or digest for the guidance of Medical Officers of Health by which those whose duties were in inland districts might the better understand the question and the want of an international congress on the subject being held in England. He would suggest a reference to the best books and authorities on the question as part of the scheme.

Dr. J. F. J. Sykes (London) seconded the motion.

Dr. J. W. Mason (Hull) supported the resolution, which he considered very important; his corporation had great confidence in the wisdom of those meetings, and made him their delegate. He hoped he should always meet them on those occasions and that other corporations would emulate Hull.

Dr. J. Tatham (Salford) cordially supported the motion, remarking that the fact that it bore Dr. North's *imprimatur*, would go a long way towards its general adoption. The Conferences should be made a separate section of the Institute for the simple reason that they give a practical turn to the whole of its work.

On "Localised outbreaks of (a) *Typhus Fever, and* (b) *Infantile Diarrhœa," by* E. W. Hope, M.D., D.Sc., Assistant Medical Officer of Health, Liverpool.

Outbreaks of disease of an infectious character, however limited and unimportant they may appear to be, deserve the closest attention that it is possible to give them. Whether the progress of the disease be arrested at once, or whether it take a sufficiently firm hold to constitute a more or less limited epidemic, lessons of the utmost consequence may be learned both in regard to the nature and manner of spread of the disease, as well as in testing the efficacy of the preventive measures employed.

I wish briefly to lay before you an account of one of our localised outbreaks of typhus fever. This disease is one which

is never absent from the city. Since sanitary records of Liverpool have been kept, probably not a week, certainly never a month, has gone by without some cases of this disease being brought to light. During the years of the last considerable epidemic, viz., in 1882 and 1883, the cases were numbered by thousands; but since that date they have undergone a marked diminution, and have dwindled down to some few hundreds annually.

The starting-point of the outbreak to which I wish to direct your attention was with a man named Logan, 56 years of age, who lived at 23 cellar, Menai Street. This man, whose children appear to have been ailing some few weeks previously, died on May 7th, at his home. The disease was not recognised during his lifetime, and it was not until the careful investigation which subsequent circumstances gave rise to, that its real nature became apparent; no suspicion of typhus had been aroused, and the death was attributed to that form of illness which the symptoms appear to have most closely simulated.

The body remained in the cellar in which the man died from the 7th to the 10th of May. There were two circumstances which attracted a number of young girls to this cellar: one was that sweets were sold in it, the other was that Logan's children were girls. Whether these were the causes or no, a number of young girls did go to the cellar, and attended the wake which was held there, several of them remaining a whole night, and others looking in repeatedly during the period that the body was in the cellar.

After the lapse of ten or eleven days, some of these girls, whose ages ranged from nine to fifteen years, fell ill. The sickness being of an anomalous character, it was reported at the Health Office, and, as the result of a close inspection, the following, who had attended the wake, were removed to hospital, suffering from typhus fever:—Mary Welsh, Martha, Julia, and Kate Morgan, Cressy Hannaway, Sarah Simpson, Mary McCormack, Elizabeth Jones, Elizabeth McEvoy, Ann, Lucy, and also Mrs. Duffey.

The inspection of the district was repeated several times, at intervals of a few days. By this means, patients infected by these children were discovered as soon as they fell ill and promptly removed to hospital. By adopting the usual practice in regard to disinfecting and cleaning the houses, the disease was suppressed after a total of about fifty infected persons had been removed and isolated in hospital.

The district is a densely crowded one, the houses being occupied by a very poor and squalid population. The plan, which is in your hands, shows the relative positions of the

streets from whence the patients came. The number removed from the various streets is as follows :—

From Menai Street,	26 Cases	From Broom Street,	1 Case
„ Landor „ ...	7 „	„ Denbigh „ ...	1 „
„ Darwen „ ...	2 „	„ Snowdon „ ...	1 „
„ Beacon „ ...	3 „	„ Calvin „ ...	1 „
„ Milford „ ...	1 „	„ Bangor „ ...	1 „
„ Trent „ ...	3 „	„ Hook „ ...	1 „
„ Athol „ ...	2 „	„ Hopwood „ ...	1 „
		TOTAL	51 Cases

Without troubling you with details as to the dates of removal of these patients, I may state that twenty-four of them were removed during the last few days of May, twenty-two during the month of June, and the remainder during the first week of July.

The various elements of danger in this outbreak deserving of special note, apart from the character of the district and the population, are these :—

There is, first of all, the failure of diagnosis in the initial case. The poor man is hidden away in his dimly-lighted cellar, seen perhaps once or twice by the doctor; treatment is directed to the prominent symptoms which seem to have masked the real nature of the disease, and no precautionary measures are adopted.

The next element of danger lies in the fact that *children* were attracted to the wake. We well know that with equal degree of exposure, children are far more susceptible to typhus than adults ; had an equal number of adults attended the wake, it is exceedingly probable that far fewer would have been infected. Finally, there is the fact that the symptoms of typhus fever in children are obscure and ill-defined, mild in course, non-fatal in result ; differing widely from the characteristics which mark the disease in adults. Hence there was every likelihood that some at least of these ten or twelve cases would escape detection.

The methods employed in this case are the usual ones, the aim and endeavour being to ensure *early* removal of the patient and thorough cleansing of the house. When these means are adopted, and the patient removed, say, before even the eighth or ninth day of illness, we find, as a general rule, that there is no further spread of the disease, but longer delays than this are exceedingly dangerous.

Combinations of chance circumstances, such as those which I have narrated, furnish starting points for an epidemic of the most serious magnitude. My belief is that epidemics of this disease, as well as of some other diseases, do owe their origin

entirely to casual combinations of such circumstances, rather than to meteorological or other obscure conditions which are often supposed to influence them. A dead man in a cellar infects ten of the persons visiting that cellar. These lie for a time in squalid crowded homes, and are in turn the means of infecting others. This process, if not arrested by prompt and vigorous means, must inevitably result in disseminating infection far and wide. One lesson, and a most important one, to be learned from this case, is the necessity for unceasing vigilance on the part of the Health Authorities and their officers.

It was my desire to quote other somewhat similar series of cases, but instead of detaining you on this ground, I would with your permission briefly direct your attention to a singular outbreak of fatal diarrhœa at the Foundling's Hospital, the facts in connection with which are of considerable interest.

The institution in question was originally a large private residence; early in this year it was put in thorough sanitary condition and adapted to its present purpose.

On July 7th there were ten infants in the institution, all of whom were then, and had been previously, in ordinary health. On this date another infant, Lily Kelly, aged two months, was received into the Hospital and placed amongst the other ten. They had a day-ward and two night-wards, but were all together at certain periods of the day. The child Lily Kelly was, on admission, suffering severely from diarrhœa and vomiting, her evacuations being so offensive as to make the nurses sick. Within a day or two of her admission seven of the other infants, as well as the two nurses, Esther Kennedy and Jane Allen, were suffering from diarrhœa. The Matron then separated the four healthy ones altogether from the rest, and these four remained in a healthy condition. In the case of the nurses the diarrhœa lasted three or four days; in the case of the seven infants the diarrhœa, at first trivial, developed into a severe illness: the infants were suddenly seized with acute symptoms, collapse, cramps, and apparently great agony; in each case but one they rallied from this, but exhaustion followed and death ensued in the following order:—

Name.	Age.	Date of Death.	Length of Illness.
Lily Kelly	2 mos. ...	July 19th ...	12 days.
Grace Kinsey	9 „ ...	„ 19th ...	6 hours.
Dorothy Smith ...	11 „ ...	„ 21st ...	5 days.
George Pearson ...	3½ „ ...	„ 25th ...	10 „
Mary Lee	2½ „ ...	„ 25th ...	10 „
Edward Holloway ...	4 „ ...	„ 27th ...	8 „
Isabella Wyse	17 „ ...	„ 29th ...	5 „

All of the infants were artificially fed, and great care appears always to have been exercised in their dieting. The same conditions as to weather, &c., existed prior to the outbreak, and the uniformity in symptoms and sequence of cases left no room for doubt in the mind of the Medical Officer of the Institution that these infants were infected in some way by the child Lily Kelly, admitted on July 7th.

With this view I fully concur, since the facts corroborate what I have observed over and over again under ordinary domestic conditions, viz., that when acute autumnal diarrhœa attacks an infant, other infants, or young children, or even occasionally adults, who happen to be brought into contact with the sick one, do themselves very frequently develope symptoms similar in kind, though modified in degree. That effluvia from offensive fœcal excretions are capable of exerting a prejudicial influence upon those who inhale them is beyond question; it seems a point of common sense that infants suffering from acute autumnal diarrhœa should be so isolated that their evacuations shall not possibly become a source of infection to the other young children, or other members of the family.

Mr. S. W. North (York) said some two years ago he investigated about a hundred and sixty cases where children had died from diarrhœa, and he found that the cases where there were two sick in one house were very rare; he believed there was an epidemic and contagious form of diarrhœa, but the majority of cases of summer diarrhœa were not of an infectious character.

Dr. J. F. J. Sykes (London) said that in his district typhus was happily unknown; it was purely due to local congestion of a population with insanitary habits, and the remedy was so simple that it was nothing short of a disgrace that typhus should exist at all; and he sincerely trusted Dr. Hope would try to stir up the Liverpool people in this matter. As to diarrhœa, he believed there was a good deal directly due to injudicious feeding. He thought with Dr. North that infectious disease also did frequently exist as a cause, and it was their important duty to try and differentiate between the two; they should not attribute it all to germs in the water, although it was probably one of the many causes, for diarrhœa was only a symptom of various diseases.

Dr. F. M. Corner (Poplar) said that according to his experience,

which was not great with regard to typhus, it had been due to the habits of the people; certain families would live like pigs, and everything would get into a shocking condition with animal reekage. Undoubtedly this disease arose through crowds herding together, and the filthy habits of this class of people. In gauging the mortality of diarrhœa they rarely found out whether the cases were hand-fed or from the natural milk; it was a great shortcoming in their returns, because many of these deaths should be attributed more to injudicious feeding than to diarrhœa attack.

Dr. J. F. Tatham (Salford) thought Liverpool ought to be congratulated on the fact that it had an assistant Medical Officer of Health with a remarkably good temper. It was enough to make one's blood boil to read in his report that so recently as the years 1882–3, the cases of typhus were numbered by thousands. He did not think the medical men had acted as they should have done. The Corporation of Liverpool had spent thousands of pounds in rectifying unhealthy areas; the health committee of the city had not been supported as they ought to have been in their effort to provide for the compulsory notification of infectious diseases. The present state of things was a cruelty to the public and to the poor wretches who were exposed to the ravages of this frightful pestilence; it was also an iniquity to the other authorities living outside. It appeared to him that Liverpool acted as a fever manufactory for the whole of Lancashire. They in Salford had frequently cases of typhus imported from Liverpool, and they were undoubtedly prejudiced by the fact that Liverpool did not possess powers for the compulsory notification of infectious disease. The facts stated by Dr. Hope showed the necessity there was for the keenest vigilance on the part of Health Authorities and their officers; they had to run great risk, even of their lives, by their daily contact with typhus and other fevers; and if only for this reason, they ought to be clothed with those protective powers which most other great authorities in England possessed. He felt a little ashamed of his professional brethren in Liverpool, that they would not allow the authorities to obtain these powers. Dr. Hope's paper was a serious indictment against the state of things at present existing in Liverpool.

Dr. E. W. Hope (Liverpool) said it was certainly a most extraordinary thing that they had in Liverpool such an enormous amount of this disease after it had been stamped out in almost every other town. They had in Liverpool, however, an immense poor labouring population, and notwithstanding the large staff of lodging-house inspectors and sub-let house inspectors, their mode of life was something beyond description; it was shocking to see the manner in which these wretched creatures liked to huddle together. If turned out of one district they migrated to another, and quickly made it as bad or worse than the one they left. He made it a practice not to go into these houses until the windows had been opened for some

minutes, and he gave the inspectors similar instructions. He believed the people of Liverpool would welcome some measure for compulsory notification, and he thought the medical profession would also, did they know of the amount of evidence collected during late years. It might have been that the matter was prematurely brought forward, or that evidence was lacking to show the absolute necessity of it previously; but to his knowledge hundreds had suffered, and hundreds of persons had lost their lives owing to the want of some system of prompt notification. It seemed at one time to be looked upon almost as a point of honour to throw every difficulty in the way of the Medical Officer of Health in this respect; he hoped this feeling was rapidly disappearing. Immense structural alterations had taken place at Liverpool, and it was gratifying to find that the cases were dwindling down from thousands to hundreds, owing to the great sanitary operations carried out in the city.

SECTION II.

ENGINEERING AND ARCHITECTURE.

ADDRESS

By Prof. T. Hayter Lewis, F.S.A., F.R.I.B.A.

PRESIDENT OF THE SECTION.

In availing myself of the privilege of addressing the members of the Congress in this active and stirring town, which is spreading itself out in every direction, I have thought it well to bring before them a subject of great interest, but which has not been hitherto much discussed, viz., the extension of our great cities and the erection of new ones; and to suggest such a course as would ensure that such requirements as are now considered to be necessary for their healthful occupation may be provided for at the outset.

In ancient times the creation of a new city almost implied the foundation of a new colony.

In mediæval times towns have risen round monasteries or churches of Bishops,* as Mr. Freeman shews was the case at Wells, Lichfield, and Sherborne; or round a castle, as at Windsor and the Yorkshire Richmond.

But, within our own times, numerous towns, such as Fleetwood, Crewe and Southport, have suddenly sprung into being; whilst, from each of our large cities, extensive suburbs are being pushed out, forming, in fact, new towns.

Of the conditions to be noted in selecting a site for a new city, we have descriptions by writers of all ages, from Vitruvius in the first century to Dr. Parkes in his well-known work of our own time. But this is a subject too large for a short address, and it is of the extensions only that I wish now to speak. They have, almost invariably, been carried out by speculators without any general definite guiding plan, with little or no forethought

* Freeman's "Exeter." p.

for future extension, and with slight provision for supplying the inevitable future wants of the inhabitants. Thus, in course of time, spaces have to be cleared out for churches, schools, institutes, baths, and such like edifices as are now required for a large population, and clearances have to be made to allow for its free breathing. The extension of the cities take place in different directions and from different motives.

The well-to-do citizens leave their smoky town and confined houses to form new suburbs, where they may breathe freely in their open gardens.

The artizans cluster together at first for cheapness and for nearness to their work. Then comes overcrowding and then sanitary acts, and then suddenly the neighbouring fields are invaded, and acres of ground are covered with new small houses, put up as a speculation in the cheapest way, with just so much breathing space as the Local Bye-Laws (if there be any) will allow.

Now if this be the time of activity in building new towns and extending old ones, it is also pre-eminently the time of activity and power in corporate bodies. From Town Councils to Vestries—from Trade Guilds to Trade Unions—from companies formed for their own benefit and companies formed (all honour be to them) for the benefit of their fellow citizens—an active part is being taken in public work.

New and extensive powers are being acquired and exercised by Corporations for the sewage, the supply of water* and of gas, for providing open spaces, regulating the width of streets, and even the height of rooms and size of windows. Your own Bye-Laws are sufficient evidence of this.

Now I simply wish to extend these powers. I wish that when it may appear evident to a Corporation that any district will require before long a large accession of houses for a population which is clearly increasing to an overflow, such Corporation shall have the powers (and I think that public opinion will require it to exercise them) to acquire control over the requisite land—to formulate a general plan, giving the width and direction of the streets—to provide spaces for such public buildings as are certain to be required in a well regulated community, and for such open spaces as are required for its healthy enjoyment.

My scheme is not a very grand one in any respect; I simply want to provide at first for those requirements which must eventually be provided for, and which can only be fulfilled at a great cost, and even then imperfectly, if not so provided at first.

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* Bolton Corporation Waterworks, 1881, and Bolton Corporation Act, 1872, 1877, & 1882—pp. 8, 26.

I do not even suggest that the Corporation should build, but that it should give general guiding directions, leaving the working out to private persons, or to such companies as have of late done so much good in building dwellings of various classes, from the highest to the lowest.

To show that such powers as I have indicated might well be called into being on behalf of even a high-class district, I might have brought before you the earnest attempt made, some thirty-five years ago,* by the late Professor Cockerell, R.A., to obtain a public control over the proposed buildings at Hampstead, a suburb now covered with houses.

As I was reminded by my friend, Mr. Rogers Field, the Professor drew out a design by which the whole of that suburb might have been built over on one definite plan, utilizing the various hills and valleys, so as to take every advantage of its picturesque beauties. Public opinion was not ripe for such a course then, and this grand opportunity was lost.

But I found that this example would be too large a one to handle here, and I have, therefore, taken as my text a smaller district near London, actually built over within my memory. I shall point out, first, its defective arrangement, and secondly, the way in which, by a little foresight, the defects might have been avoided.

The houses in this district are of various classes. Some of them are good private dwellings, with forecourts and trees. Many others are tenanted by a superior class of artizans; whilst other portions of the district realise the description given by Mr. Walter Besant, as being composed "of small houses almost all of one pattern—with no green thing to be seen—where no one plants trees. No flowers are in the windows—nothing to gladden the eye."†

And portions even realise the darker picture drawn by Mr. Froude, who describes the dwellers in such a district as having "no sight of green fields, no knowledge of flowers, and with no entertainment but the music hall."‡

The sketch of this, the worst part, may be fitly illustrated by a notice put up at the private bar of one of its chief public-houses, that, "Ladies cannot be admitted unless properly attired, nor without hats or bonnets."

The district is still growing rapidly under the auspices of the speculator, who is building acre upon acre of houses with just so much care and attention as will allow him to obtain

* *Vide* "Builders' Journal," Vol. XI. (1853).
† "All sorts and conditions of men."
‡ "Oceana," 1886. p. 9.

the highest rent at the least cost. That the case may be better understood, I have enlarged a plan of the district from the Ordnance Map; but not one half of it was built over at the time this map was made, so I have completed it by filling in the new streets from numerous personal visits to the spot, and have drawn it as plan No. 1. It is bounded on the west and south sides by a railway, whose course is marked partly by a dead wall and partly by a line of old sleepers, placed upright, whose outline is somewhat relieved by their tops being cut to a point, and whose sombre tint has also some little relief by the marks left by the rusty iron bolts and by the painted tops being tarred black. By the side of this dismal fence runs the main road, about 30 ft. broad, not wide enough for a footway on each side; its one narrow path next the houses being crowded with foot passengers, and the road itself made narrower by costermongers' carts and stalls.

On the north-west side the boundary is a really good road nearly 60 ft. wide.

At the north-west angle (A) where these two roads meet there is a railway station, receiving and discharging thousands of passengers every day, and at (B), to the south is another station.

To the east (E) are spaces as yet unbuilt upon.

Now my plan will shew the extremely haphazard way in which this district has been filled up. The builders have acquired one field after another and followed its irregular forms, or those of the country cross roads or ditches, in laying out their new streets, and the result is about as bad a plan as it is possible to imagine—not in the slightest degree picturesque, simply puzzling and exasperating.

One of the chief features in the district, the railway station (B), is altogether ignored, as it opens now merely on to the narrow road, with no street opposite any part of it; and as you will see, a large number of the streets have dead ends to them, completely closing them against through ventilation, and very many more are not thoroughfares. You will see clearly the reason of this in one case, viz., near the station (A).

The builder who took the ground near to it, built the streets up to the extremity of his odd-shaped fields, which I have indicated by the street hatched on the plan, and used every inch of his ground, not leaving a vacant space for any opening eastward. So when the builder of (C D) came, he could not get any of his streets to open on to the station, and was obliged to run new streets with their dead ends as I have shewn, there being for the whole length of (C D), which is more than a quarter of a mile long, not a single opening to the west.

The further and important result has been, that the whole of the district eastward has been shut off from the main station (A), to which the slightest foresight would have given it an easy access. I have been fairly well used to explore strange towns here and on the continent, and rather pride myself in being able to find my way, but I candidly confess that I have very seldom paid a visit to this district without being sorely puzzled as to my readiest means of getting out of it.

The houses which face the main roads are mostly good private houses or shops, and many of these are three stories high. The rest are, as a rule, private houses, but only two stories high, thus giving an admirable example of Horace Walpole's sneer at London, as being "a gigantic mass of littleness."

Standing on one of our bridges and looking at the magnificent and unequalled range of spires and towers crowned by the dome of St. Paul's, one feels astonished at his insolence. Go to our suburbs and one feels its application.

Now what I want is, I repeat, to shew how, by a very little forethought, a corporate body could so arrange the site of such a suburb or town as to have the same number of people at the same cost and on the same space of ground as is now covered, making such provision as would make it healthy and cheerful, and provide, at the outset, for such public buildings as must, we know, be eventually required.

The necessity for some such provision has been repeatedly recognized, and you will find in the Appendix to the report of the Poor Law Commissioners, 1842*, signed by the well-known name of Edwin Chadwick, a suggested plan by Capt. Vetch, R.E., for laying out the suburbs of Birmingham.

He says, "one of the greatest evils arising from towns extending at caprice without reference to any general plan, is the vast expense that subsequently arises when necessity demands communications to be made through crowded masses of streets. Such events are of frequent occurrence."

He further shows the proposed extension laid out in a network very much on the same principle as I shall have to shew to you.

Sir Christopher Wren's great plan for rebuilding London will come at once to your memories.

The subject was brought prominently into notice by Lord Salisbury's well-known paper in the *National Review* (1883), but little has been done except perhaps in Glasgow, in which a large district of houses was laid waste in order that it might be rebuilt in a better manner.

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* Report from Poor Law Commissioners, 1842. Appendix, p. 384.

That, however, rather emphasizes my suggestion of preventing any such necessity by making suitable provision from the first, and allowing corporations to do just what many of our great landowners, as the Bedfords, Westminsters, and others in London have done on their own estates. And in suggesting as I am now about to do, the manner of doing this I have, as I before stated, no Utopian schemes in view.

I simply take the conditions of life as I find them, and shall not suggest any provision for streets or buildings, public or private, which are not founded upon some actually existing, and which I can cite as my authorities. To bring the case before you as clearly as I can, I have drawn out a map No. 2 (p. 216) of the district, with the streets, &c., rearranged as I would suggest them to have been laid out from the first.

You will see that it is drawn on the strictest utilitarian principles; that I have resisted all attempts at crescents or other curved lines, which would produce, no doubt, a much more pleasing effect than I have done, and that there is not one single frontage which is not straight.

All that I have done has been to ensure a ready access from any one part to another, and to provide that each street shall have its ending in a wide well-ventilated thoroughfare.

I don't propose it as the best plan that could be framed. Doubtless many here will suggest a better one.

Each district, too, will probably have some local peculiarity or object of interest, suggesting a varied plan, such, *e.g.*, as the great Church of St. Paul, the Exchange, the Tower, the river, which formed the keynotes to Wren's design, and as the prominent hills furnished the leading lines in Prof. Cockerell's: or it might be some old ruin, something to make one think and to conjure up memories of bygone times, sermons or histories in stone, and so be religiously preserved.

But unhappily my district has no hill, no view, no river, and we have to think only of stations and tramcars.

The north-west boundary road is of sufficient width, but you will see from No. 1 (p. 216) that at present there is, with the exception only of the street (C D), which leads to a footbridge, no direct communication from it anywhere to anywhere, and that the boundary road (A B), next to the railway, is very much too narrow for its great traffic, whilst its dirty wall and fence, and absence of footway, make it about as dreary as well as inconvenient a road as I know.

But it is the direct route to the country beyond, and I would not alter its course, but make it broader, and thus get a good footpath on each side of it.

Having now taken the two boundary roads as following the

existing lines, we have to determine the direction of the main intermediate streets, the first consideration being of course the probable direct lines of traffic.

The chief are indicated vaguely by the series of streets (F, F, G), in No. 1 plan, which follow the lines of an old causeway, winding about in a way which is utterly confusing to a stranger, and leading *away* from the station (B).

This is somewhat beyond a half-mile radius from the main station (A), and nearly the same as from this square to the Heywood Recreation Ground; and I would follow this line, in its general direction, by a wide avenue (F F) in No. 2 plan, leading directly to the station (B), which is absolutely ignored in the present streets.

The form of the main boundary would vary, of course, in each locality according to the general course of traffic, inequalities of the ground, and other such causes.

In the present case I have given it the form shewn, as affording a pleasing contrast to the ordinary straight lines of the streets.

I then form another avenue (C D) on No. 2 plan, taking much the same lines as that on No. 1, and then intersect the whole by the avenues (H, H, H, I); each of these avenues being planted with trees, as at Southport, and as our new streets and some of our old ones are being planted in London: and I do insist that such wide well-planted main thoroughfares are of the greatest importance as regards the health of a town.

They would secure a thoroughly good ventilation through the heart of it, and would give it a cheerful aspect; and I am not sure as to which of these two provisions is of the most vital importance. We recognise the aid to health which a cheerful aspect in a hospital ward affords us: surely the same aid will be given towards *maintaining* health, if the same rule be applied to our streets, no matter in what station in life their inhabitants may be.

You may say that there is the dead wall by the railway, and you cannot make that cheerful. Well, I ask you to remember what has been done with the great ugly railway embankments which cross the beautiful park at Preston, and which have been rendered so sightly by a little care that I doubt, even if we had the choice, we should like to see them removed. I want my wall to be treated somewhat thus, although more simply, and not until houses are built in face of it.

Then I shall be told that the trees will not be allowed to grow—that the roughs will not let them. Now I will not go so far as my son, who had a curacy in one of the roughest districts of London, and who says that he liked the roughs—he could always manage them. Now I *don't* like the roughs,

and I do not think that I could manage them; but my district is not much infested with roughs; and we have planted trees in even some of the worst parts of London, and the trees are none the worse for it.

You will say, looking at my own plan, No. 2, that it is made to look prettier than No. 1 by the trees, &c.* Of course it is, and I so intended it; but I will venture to say that the contrast between the two plans is not nearly so great as the contrast would be between the two districts themselves.

No doubt nearly every large town has now a park (and there are few prettier than your own), but we have to *go* to it. It is, and must be, away from most of the houses, and I do insist upon the fact that the cheerfulness of the home (no matter on what scale and of what class), with its surroundings, is the great thing to be studied; and I see nothing to be said against bringing close to every street, by such arrangements as I have shewn, the cheerfulness of bright foliage and open air.

I now ask you to bear with me whilst I enter, in some detail, as to the public works and buildings for which provision should be made. I assume that, as a matter of course, the sewers, water, and gas, will be provided in the usual way, so I need not detain you as to these.

In the first place I would set aside a strip of land (E) outside the whole for the park, which I take for granted would ultimately be required, no matter what the rank of the adjoining houses may be. Its distance from the furthest point would be about that suggested by Mr. Besant, viz., half to three-quarters of a mile. The size which I suggest is about the same as that of the Hesketh Park at Southport, which is in one of the best parts of the town, and much smaller than the one here. The position of this open space would provide well, also, for the future extension of the town, and would afford the advantages obtained in the same way as, *e.g.*, at Hastings, where the pretty St. Andrew's Gardens, starting from the old town, pass round at the back of the houses, and are continued to St. Leonards, making an admirable belt of free open air and foliage.

Neither in this case, nor in that of public buildings, do I propose the work to be undertaken at the first, but only so to arrange, *at* the first, that the sites shall be so reserved as to be available when required. As to these I need do no more than mention offices for the local authorities, and the library, reading-room, science and art schools, and other buildings required for the particular locality.

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* The trees, &c., have not been reproduced in the lithograph.

In the arrangement of these public buildings it would be difficult to take a better example than that of Southport, whose Lord Street and Albert Road form one of the prettiest vistas that I know—(I trust that Birkdale will pardon me for classing it with its neighbour)—and I use the word "prettiest" advisedly, as I could not, of course, compare it with such grand thoroughfares, each unrivalled in its way, as the High Street of Oxford, or Princes Street at Edinburgh.

At Southport the chief public buildings are located behind a group of trees, and I know of few more pleasing views than that of the spires and turrets of Christ Church, the Presbyterian Church, and the municipal and other buildings, towering above the foliage, whilst between the trees the buildings themselves are picturesquely seen. I suggest that a similar arrangement be made here for such buildings, and others mentioned hereafter, in a central position, such as (L) and (K).

Outside the park I should place the infirmary and convalescent home, a position in which they would have free light and air. If any one suggests that such a position would be too public and lessen the enjoyment of the park, I would refer him to your own infirmary and children's hospital (the latter the gift, I believe, of your townsman, Dr. Chadwick, and his family), and ask him whether, as a simple matter of landscape effect, to say nothing of the value of such an outlook to the patients, he would wish this picturesque building, designed by one of your able townsmen, Mr. Knill Freeman, to be removed. Or again, think of the charming way, and without the slightest feeling of sadness, in which the promenade at Southport ends with such a building, whilst at two such different places as Manchester and Hastings, the infirmary forms one of their most prominent buildings. Next to your noble town hall and the old churches, the most important building is, I think, the market. I do not of course propose any such grand building as yours for my district. It might be open at the sides, but covered as at Preston and Blackpool, or be enclosed as here and at Southport, or St. John's at Blackpool. I know that many towns of importance (I may, I think, name Norwich and Cambridge amongst them) have still little more than open and uncovered market places, healthy looking and pretty, with fruit, and flowers, and vegetables, on a fine day; but we often have quite other days in our country, and the attempts at covering up and protecting the stalls then, turns the market place into a wretched collection of tumble-down huts—I had almost said as bad as Fleetwood. If the quarter be chiefly for artizans, public washhouses will be indispensable; and in any case, no matter what the class of inhabitants may be, I look upon public

baths also as a provision which can scarcely be valued too highly. For these baths and washhouses I have suggested no definite site, as this would depend so very much on the kind of inhabitants.

Nor have I marked out definitely sites for churches, chapels, or schools. All these are provided for in the district as it exists, and sites would undoubtedly be claimed for and provided, whatever the general plan might be.

I come now to some other details, as to which I may not possibly have your assent.

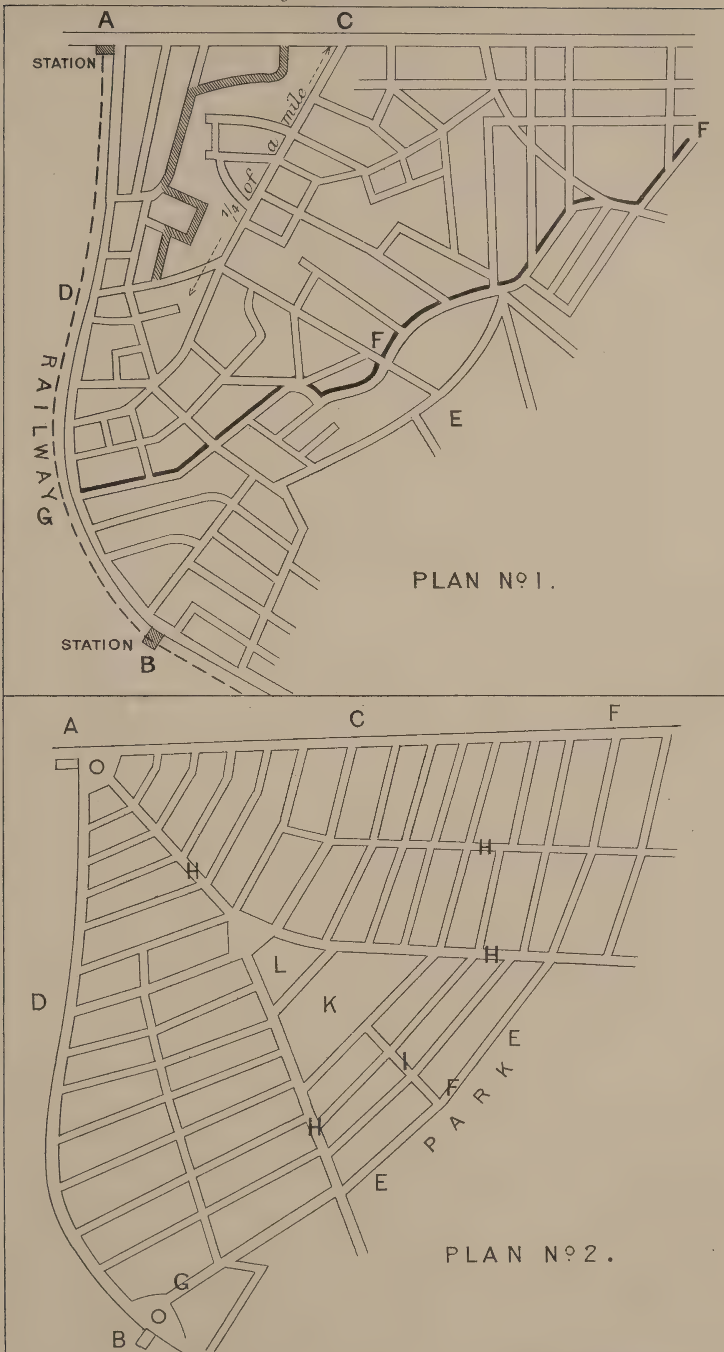
First, as to drinking fountains. That such small ones as are now commonly seen should be provided, you will doubtless quite approve. There are many excellent examples in most of the towns in these parts, each combining a drinking fountain with a public lamp, and being really an ornament to the streets. But I want something more than these, as much for the sake of health as for ornaments to the town.

You know well enough that all the water in use for your houses is stored in cisterns; and although in past times these cisterns were looked upon as being worthy to be seen, and so were ornamented in a way which is now the envy and admiration of workmen and artists alike, they are now rough ugly things, stored away out of sight in any convenient closet or loft which will hold them, and for all that their owners know of them may be considered as the property of the spiders.

You depend upon your plumber to clean them out once a year. Perhaps he does; perhaps he doesn't. You are none the wiser. But imagine what often happens in the houses of a poorer class. I need not go into details, but I say that a good supply of water, pure for drinking, is an element of health which ought to be provided, and that you can't provide it in a better way than by fountains. These, in what are now called the dark ages, formed some of the chief ornaments of a town, and I see no reason why they should not do so now.

I don't want to bring in such vast bodies of water as were brought through miles of aqueducts into Rome, or such lavish displays as you have seen, *e.g.*, in Paris, or even such things as our fountains in Trafalgar Square. Nearly all these send their waters into the drains.

There are fountains even now in most of our towns—a very elegant one at Southport, for example, but, again, with all the water running to waste; whereas in some of the most picturesque mediæval examples it came out in small useful jets, as I would have them here; and I feel no doubt that, by a skilful arrangement of gas jets, the effects of frost might be prevented, and a great boon thus conferred in winter, on rich and poor alike;



Stanford's, Geog.l Estab.t

whilst, by a skilful design, they could be some of the most pleasing ornaments to the town that could be conceived. And, as part of the water must go to waste, send it to feed a small stream in the park, like the one here or at Hastings, and get the refreshing sight and sound, sung of by Longfellow:

> "Of the brooklet gushing
> From its fountain near;
> Down the valley rushing,
> Fresh and wondrous clear."

Years back it would have issued in the words of the same poet:

> "To fly
> To the sea's immensity;
> To wash from it the slime
> Of its muddy banks."

But we can provide against that now.

Another accessory I must mention is that of seats placed at intervals between the trees. I shall, no doubt, have the same objection made to them as to the trees, and my answer would be the same.

Then to complete my plan I would have a small open space (O) opposite to each railway station. Now we have to see, before entering into the question of the kind of houses to be provided, how much the plans which I have suggested have trespassed upon the space now occupied.

I have laid out my main roads in very much the same general direction as the present ones, though in less circuitous lines; but I have made them 60 ft. wide instead of 40, and have set apart spaces for public buildings, &c. The smaller streets I have made 40 ft. wide, the width required by the Model Bye-laws being 36. The space which I have assigned to the park need not be taken into our calculation, as it is altogether outside that now built on; and I think you will readily see that the great waste of space necessitated by the irregular plan of the district as now actually existing, would allow to a very great extent, if not altogether, for the extra space which the suggested rearrangement would require.

As to the general arrangements of the streets and houses, I will call your attention to some methods, unusual to us, with which one meets abroad. I omit any notice of the large many-storied houses which are familiar to you on the Continent, and I shall take, as examples, one of the northern towns in Europe, Hamburg, and one of the southern ones, Naples. Several years since, I was commissioned to make a detailed report on the former town, for one of the principal Insurance

Offices (the Union) of London, and I was thus led to see more of it than, perhaps, most of the people who visit it. The arrangement is peculiar. The main streets are wide, and give to a casual passer-by scarcely any indication of their affording access to any other streets.

But a nearer inspection shews numerous doorways, so low and narrow that they appear to lead only into cellars, and through which you have, often, to descend by steps, and these lead into the streets behind, locally named Hofs, which we should call alleys, and which are of course completely closed against ventilation from the main street. They vary from 20 ft. to as little as 5 ft. in width, the houses in the wider streets overhanging on each side and being densely populated.

They usually abut on canals, and when these are dry the result in hot weather may be imagined.

This arrangement, intended, no doubt, to bring different classes of the people together, reminds one of the Wynds of Edinburgh, but with all their evils intensified, and a worse result could scarcely be imagined. Very many of these have been demolished, but a large number still remain.

I take you down now to the sunny south at Naples, where the same attempt has been made.

It is not in my province now to describe the ordinary houses there, of the horrors of which Sig. Gallenga and Mrs. Oliphant have given most vivid descriptions, but only the particular class to which I have alluded, and which may be seen, to perfection, in the drive through Portici.

The streets throughout are wide, and lined for the greater part of their length with frames of macaroni hung out to dry, and many here will, no doubt, well remember both the sight and the smell. The houses on each side are several stories high, the first floors *(piani nobili)* having wide balconies, and altogether having a cheerful look and being tenanted by well-to-do and often wealthy people, whose apartments are entered from an internal court approached from the street by a lofty carriage gateway, through which one has lovely glimpses of beautiful gardens sloping down to the Bay of Naples. But the lower stories throughout, close on the ground, are tenanted by humbler classes, their rooms entered from the street.

Here again we meet with an attempt to combine the classes, and thus prevent one neighbourhood being given up to the poor and another to the rich.

But again this fails. The lower rooms have no windows or other openings at the back, and derive the whole of their light and air from the street. The state of the inner rooms (usually parted off by a curtain as sleeping apartments) in the heat of

an Italian summer may be imagined; and these rooms are not inadequately described by Mrs. Oliphant as "dark caverns with one vast door, giving all the light that can penetrate."* Were it not that the people live almost entirely in the open air they must be decimated. The same arrangement will be found in most other Italian towns, but in them there is, usually, some opening, however small, at the back.

Something of the same kind would appear to be adopted, judging from the plan only, in a flourishing town in our own country, viz., Great Yarmouth, the arrangement of which is very peculiar, and unlike that of any other English town with which I am acquainted. I have a drawing of this, enlarged from one which was kindly drawn for me by Mr. Arthur Hewitt, an architect in the town, who has supplemented the Ordnance map by many important details. The main streets are wide and well ventilated, and lined with good houses (mostly shops) several stories high; and running between these streets at intervals of about forty-five feet are long narrow alleys, termed Rows, out of which lead houses of an inferior class.

Looking at the plan only, this would seem to be no better than Hamburg; but in reality they are *vastly* better. The entrances are open for their whole height to a wide street at each end, or to the spacious quay, the alleys are cleanly kept and well paved, the houses in them are low, so as to intercept the light and air very slightly, and each has a small court attached to it; and the whole arrangement, so far as I can ascertain, is not prejudicial to health.

Nevertheless, the narrowness of the streets does, no doubt, to some extent, clash with the golden rule which Dr. Richardson put very strongly in his well-known lecture at Croydon (1879): "Make the sun your fellow-workman," which is much the same as the Italian proverb, "Where the sun does not enter the doctor does."

Now, in remodelling our district, what system shall we adopt as to the houses? The first question is as to their number of stories. This subject is a serious one, for hundreds of acres near our towns are now being covered with two-storied dwellings, clustered close together in populous neighbourhoods, or semi-detached when more in the suburbs. As to this, I do not wish to lengthen my paper by going into any argument, but I must briefly allude to some of the leading facts. The governing idea in respect of the self-contained houses of two stories is, of course, that of privacy, or, in the better class of houses, the absence of stairs; but, in many of our new London squares, one

* "Francis of Assise," 1885. p. 2.

large open space garden, or yard (according to the class of house), is common to all; and the separate houses are being largely superseded by the dwellings in flats. At the first sight the two-storied houses would appear to have the recommendation of ensuring a less dense population than in the many-storied ones; but I wish to consider the subject on the basis of the same number of inhabitants in each case, the area gained by the extra stories being appropriated to open spaces in the way of yards or gardens, so that no question as to the bearing of the density of the population upon their health will arise here.

In considering the relative merits of the different styles of houses, the first fact which presents itself is, that with those of two stories only, the whole of their inhabitants must live and sleep either immediately over the ground or directly under the roofs.

I need scarcely say that the nearer to the earth the ground-floor is the cheaper it is to build, as less height of wall is required; and the consequence is that the floor is raised a few inches only above the street level, and the occupant has only that space between him and the earth. The rest of the inhabitants must live and sleep directly under the roof—not a very pleasant experience even in well-built houses, whether through the heat of summer or cold of winter; and very many here, doubtless, know what is the case where the house is run up cheaply merely to sell. In point of economy of building, and of course of rent, it must be borne in mind that, though the thickness of the lower walls must be somewhat greater in a high house than a low one, one roof will cover, and one foundation hold up, four or more stories, as well as they will cover and hold up two.

As to the general feelings with respect to the subject, I recall and agree with the words of my predecessor, Professor Roger Smith, in his address at Glasgow in 1883,* that the system of flats is opposed to the general feeling; and I agree with him, also, when he says that they are not so unpopular now, and have many advantages.

Of course the height of houses, whether in flats or separate, varies very much, buildings of five, six, or seven stories, being common enough—my own house has six; but I propose, in the comparative plans which I shew, to limit our consideration to four stories, which is the limit suggested by Professor Robinson, in his address at Newcastle, 1882.† My plan shews, first the actual space at present occupied by two blocks, each of fifty-

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* "Transactions of the Sanitary Institute, Vol. V.. 1883—4."
† "Transactions of the Sanitary Institute, Vol. IV., 1882—3."

eight two-storied houses, and their open areas of streets and yards; and, secondly the space which would be occupied and the area gained, if the same number of inhabitants lodged in half the number of houses, but four stories in height.

The contrast as to open space is rather striking, and with increased height the size of that space will of course increase.

I leave this matter for your serious consideration.

One thing more. In his well-known address in 1879, Dr. Richardson spoke of his ideal cities as competing with each other in the beautiful as well as the useful, and I have spoken all the way through of doing what we have to do in the streets, the buildings, the fountains, in such a manner as to give a cheerful aspect to the scene, and afford some scope, however slight, to the feeling of beauty which is inherent in mankind, whether for colour or form, for a flower or a building, and not to offend the eye by the mean and the ugly.

*Years back, in the prime of his life, Mr. Ruskin pointed out most forcibly "that it is chiefly by private and not by public effort that a city is adorned, and that it did not matter how many beautiful public buildings it may possess, if they are not supported by and in harmony with the private houses (and, I may add, of the factories) of the town:" and if it be held that all we have to do is to provide houses which shall be fairly comfortable whether for rich or poor, and that rows of such houses will answer all the purpose if built with windows large enough and numerous enough, and that nothing else in them need be studied to please the eye and cheer the heart, then I say that our town lacks one great feature which might conduce to the pleasure of its inhabitants, and in neglecting which, we have neglected one means, however slight, towards that healthful mental state which helps the bodily so well.

Lord Basing, F.R.S. (London), observed that in his opinion they might fairly congratulate themselves upon the auspicious manner in which that Section had been opened. The Address they had just heard read held up a lofty ideal, but certainly not a too lofty one, of

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* Lectures at Edinburgh, 1854.

Note.—I desire to express my grateful thanks to Mr. Knill Freeman, of this town; Mr. Whyte, of the office of Public Works at Glasgow; Mr. Darbishire, architect to the Peabody trust; Mr. Boutcher, of the Artizans' Dwellings Co.; Mr. Arthur Hewitt, of Gt. Yarmouth; and Herr August Herz, of Hamburg; for kind and valuable information bearing upon this subject; and also to Prof. Corfield, for kindly looking through the rough draft of this lecture.

what our towns and cities might become. The tendency to look to the Municipality or to the Government to provide ornament as well as to be a restraining force, must always be jealously guarded against. He agreed very much with Mr. Ruskin, when he said that after all most of the splendid towns and cities they knew of had been beautified at least in the greater degree by private munificence. Nevertheless it was their duty to see that due regard should be paid to health conditions in towns, and anyone who desired to form an opinion as to the mode in which the necessary improvements might be carried out would do well to study the paper they had just heard, so that he might be ready to judge by its light as to the appropriateness and effectiveness of what he knew and saw to be going on in his own neighbourhood. He had great pleasure in moving a vote of thanks to Professor Hayter Lewis for his Address.

Mr. R. H. Freeman, F.R.I.B.A. (Bolton), seconded the motion, and said he thought he might be allowed to refer for a moment to one point brought out in the Address. That was that something more than mere utility was wanted in their buildings, and also in the arrangement of their streets. He thought that the Corporation of Bolton had recognised this fact, and that their public buildings had not been dealt with entirely from a purely utilitarian point of view. They had caused to be erected structures of which the inhabitants were proud, and which they could look on with satisfaction. He had much pleasure in seconding the vote of thanks to Professor Lewis.

The resolution was carried.

On "Sanitary Apparatus for Convenience in Factories," by J. J. Bradshaw, F.R.I.B.A.

It is perhaps well to say that this paper is prepared rather as a statement of the actual facts of general practice than otherwise. A few suggestions arising out of the subject are made in such places as they naturally occur; but the object of the writer has not been to introduce new schemes so much as to leave these to be brought forward during the subsequent discussion by anyone wishing to introduce the same.

This subject is one which will not be found generally attractive, yet it is of great importance to the health of workers in manufactories, and has such special reference to the work of a Sanitary Association, that I have felt little hesitation in

accepting the invitation of the Secretaries to introduce it in as brief a manner as possible to the notice of the Congress.

The term "factory" is locally applied only to "cotton spinning mills," but this is of little importance, as the provisions required are similar to those of other manufacturing establishments, but becoming more important, and also more difficult of application, from the fact that the rooms in which the actual process of spinning is carried on must be maintained at an average temperature of about 80°.

The question of VENTILATION naturally suggests itself for first consideration, as—unlike the accidents from machinery which cannot be hidden, as they are direct in their consequences—"the evils which follow constant employment in overcrowded and ill-ventilated work-rooms are insidious in their inception, rarely complained of openly by the sufferers, and do not in their effects appeal so readily to the sympathy of employers as do the injuries to the person caused by machinery."*

The subject of this paper being restricted to factories, and therefore presumably to buildings specially intended for their purposes, excludes from its consideration the numerous cases of occupations on the small scale of those carried on in dwelling-houses, or rooms attached to tailors' or drapers' shops.

In many of the engineering and other ironworks the trade is carried out practically on the ground floor, and only enclosed with a view to protection from weather; and the cubical air space is so large and frequently changed that the ventilation is sufficiently secured without artificial aid; and in cases where special need arises, fans or other means of inducing currents are generally applied. The same remarks may be made as to the bleaching, paper-making, and other trades of this locality, but attention may perhaps be best given to the cotton-spinning trade as being the leading one of the district.

In the various processes of the spinning trade, ventilation is subject to very special conditions, as the nature of the material manipulated renders it very susceptible to variations of atmosphere, and necessitates a regular temperature, improved by a slight amount of moisture, which, in some of the processes of preparing the yarn for the weaver, must be maintained at not less than 60° during the earlier, and from 80° to 90° during the latter processes.

The case is further complicated by the difficulty of dealing with the fine dust and fluff without injury to the delicate fibre of the material; the amount of dust being much greater in all the processes of preparing coarse yarns, such as are spun from

* H. M. Inspector of Factories Reports, 1885, p. 15.

American cotton in the Oldham district, than in the finer counts spun from Egyptian cotton in the Bolton trade; the amount of dust being perhaps in proportion to the greater weight of the material used in the one case over the other, though the finer counts are more delicate and easily damaged.

By the factory regulation of non-textile work-rooms, 250 cubic feet of air space are required for each person employed during ordinary hours, and 400 cubic feet where overtime is worked; in soldiers' barracks 600 cubic feet are required; and in hospitals for ordinary cases 1,800 cubic feet, and in those for infectious diseases 2,400 feet are generally allowed; but it must be noted that in all these cases provision should be made for frequent changing of the air of the rooms.*

As regards cubical space the operative in a cotton-spinning concern is very favourably situated, the worker, even in the most crowded part of the card room, having never, in a modern mill, less than 4,500 cubic feet, and in a spinning room from 9,000 to 11,000 cubic feet of space. In weaving sheds, which are more crowded, Messrs. Bridge and Osborn, in their Report of 1st October, 1883, on "Heavy Sizing in Cotton weaving," give, as the result of their observation, a cubical space to each worker of 1,800 to 2,400 cubic feet. The same Report, however, contains an observation which applies to all these cases: "The fact, however, is that to maintain a wholesome atmosphere, an allowance of 3,000 cubic feet, or on the lowest computation of 2,000 feet, should be supplied to each person during every hour. This, in the case of weaving sheds, would imply that the air was changed once in every three-quarters of an hour, or 12 or 13 times during the working day. It may reasonably be doubted whether during that period it is changed effectively so often as once. Assuredly the slender currents of fresh air which may penetrate through crevices in woodwork, through broken window frames, or through casually opened doors, would not suffice for this."

It is thus evident that overcrowding is not one of the evils of this trade. The questions of the maintenance of an even temperature and of the change of atmosphere in all cases, and the removal of dust in most of the processes, are however more difficult to deal with. The last-named point arises in the first process—that of opening, in a room of ordinary temperature, the bales of raw material which have been closely pressed for shipment and which, when opened, are found to have a considerable quantity of dust in them, besides the occasional adulteration of sand or other worthless matter.

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* H. M. Inspector of Factories, 1883, p. 33. Order, April, 1883.

The heavier portions of this drop to the floor and are cleared away as required: the lighter portions, however, during the opening and following process of mixing the contents of the various bales, float about in the atmosphere, often making it thick with dust, from which the more careful workers protect themselves to some extent by a homely respirator extemporised from a piece of the cotton itself. There are, however, generally speaking, in each mill only a small number of persons engaged for a short time once or twice a week in these processes, which are necessarily carried on in the large area needed for the storage of bales of the raw material, and the amount of material used being much larger in coarse than in fine spinning mills.

Fans or other modes of creating currents to carry off the lighter particles of dust might be with great advantage more generally employed.

The process of scutching, in a temperature about 60° or 64°, is continuous, and carried on in a separate room. The heavier portions of dust are carried by fans in each machine into a specially formed chamber, and though these to some extent ventilate the room, there is still the constant presence of fine dust which affects the workers in it prejudicially. Inlet Tobin tubes and extracting fans might be with advantage more generally adopted, but the current must be so regulated as not to affect what is technically known as "the lap" or roll of a loosely-compacted sheet of cotton.

Carding, in a room of similar temperature, is the next process: this is also dusty, and in many cases, even in fine counts, is either carried on in a separate room or that portion of the room is screened off from the rest by glazed partitions. Many efforts have been made to clear off the dust in this process, but none has yet been so successful as to secure general adoption; the difficulties in the way of a perfect process being very great. The heavier particles of dust are to a large extent collected in the carding engine itself, and the lighter particles can scarcely be removed without also carrying away the lighter portions of the fibre. The thickest cloud of dust is, however, caused by cleaning and grinding the machines, each of which requires, for one purpose or the other, attention during the day from the "stripper and grinder," as these workmen are called.

In some instances a series of tubes, with an inverted hopper over each machine, and the whole connected to a main trunk, fitted with a fan to draw up the air and dust by suction, have been tried, and in other cases powerful fans have been placed at various points in the room, but nothing has yet been found so satisfactory as to secure general adoption, and which is at once sufficiently powerful to clear the dust and still so gentle

as not to injure the lap or the film of cotton proceeding from the machine in a long loose coil of delicate fibres to the tall can in which it is placed for removal. The other portions of the card room, when other machinery is placed in same room, are much freer from dust, and are occupied by various frames, which in succession make the cotton into a more closely-compacted and finer thread, the delicacy of which will perhaps be best understood by the general audience when the fact is stated that screens are regularly put up to protect them from draft and dust and the breaking of the threads, or as it is graphically termed "the falling of the ends," caused by the opening of a door from a staircase or any room which communicates with the external atmosphere.

From the frames the cotton is taken to the spinning-rooms: these are the most free from dust, and have to be maintained at a temperature of from 80° to 90°, and in which the thread becomes increasingly sensitive from its fineness and the rapidity of the motion of the machinery; this renders it specially susceptible to any current of air, and also to any dryness of the atmosphere, such as is caused by east wind or dry frost, and also to the presence of dirt of any kind floating about.

The delicacy of the thread and fibres after leaving the carding machines, and the needed heat of the mule-spinning rooms, the absence of all which will affect the required colour or cleanliness of the yarns, especially those of finer counts, and the ever-increasing necessity to lessen expenses in production, render the question of ventilation difficult; besides which many think it needless from the great cubical space for each worker. This last fact undoubtedly lessens the inconvenience, but there can be no question, I think, but that the health of the cotton operative would be of a more robust character, and there would be less lung and throat disease, if the atmosphere was regularly changed.

At present the need only appears to be felt when there is such a wave of heat generated by summer sun and the rapid movement of the machinery that it becomes unbearable to the workers, and this is then dealt with by the usual method of opening the swing casements provided in a portion of the windows near the ceiling; in all other seasons every cranny and aperture where cold air can enter is carefully stopped up, and if inlets for air are provided during the construction of the building, they are after a short experience invariably blocked up. I may however, remind you that any one who takes the trouble to examine the ventilators of a public building or private residence in a year or two after the novelty of their introduction has worn off, finds such to be generally the case.

The effort to apply ventilation in these cases, which appears to be the most nearly correct in principle and which has had some success in a few cases, though not a complete one, is an arrangement of steam pipes in a small trough of water over which a current of air from the external atmosphere is deflected, and enters on one side of the room and is drawn across by strong fans on the opposite side, discharging either into flues or into the open air. This plan is not yet generally adopted. If a strong wind is blowing on the inlet side, it will give much too strong a current, and if the external atmosphere be smoky, as in a manufacturing town is usually the case, it would also carry with it a large amount of soot, which would materially damage the yarn for sale.

The arrangement also requires more attention in such a variable climate as ours than would ordinarily be given to it, and is not sufficiently automatic; but it is, as before stated, perhaps the most nearly correct in principle of any yet tried.

It is evident that the problem is both difficult and interesting to secure at once, by a practical working scheme, in all weathers a nearly uniform temperature, which shall in some rooms be about 60° and in others 80° or 90°, as needed, by the introduction and extraction of currents of warm and slightly moistened air, delivered at such levels and so imperceptibly as not to damage such delicate threads, and yet be so powerful as to change the atmosphere and carry away the dust. And there is the further and most important consideration that this has to be done without, either in first outlay or maintenance, materially raising the cost of production.

In ring or throstle-spinning and in doubling rooms the operatives are more numerous, and the heat is often raised in summer to a high degree by the action of the machinery; but there is not the same necessity felt to avoid draughts of air, and the window casements are more freely opened, and in some instances extracting fans are used. In other respects the need of ventilation is the same, and as little attended to as usual.

The various processes of preparing the yarn when made, for the use of the weaver or other manufacturer, and known as reeling, winding, and warping, are carried on usually in separate buildings at the normal temperature in summer and at a temperature of about 60° in winter; the threads are less exposed and, the machines not moving so rapidly, dust is less troublesome. Ventilation is usually unprovided for except by window casements, which are opened in summer but kept carefully closed at other times. These processes are frequently carried on in connection with weaving where to be used at once, and

in separate establishments, or in connection with spinning mills when intended for export.

One special process, known as "Gassing," however, calls for separate notice. In these machines fine threads of yarn are passed rapidly through small jets of lighted gas for the purpose of singeing it, and thus burning off the almost microscopic fluff and leaving the threads, two or more of which are also twisted together, perfectly smooth and hard on the surface, as well as slightly glossy. It will be seen at once that the constant working over the numerous gas jets is trying to the eyes, throat, and lungs, and also renders the atmosphere very impure.

Many efforts have been made, with varying success, to improve these rooms. In some cases, where placed on the ground floor, flues or channels for supplying fresh air by inlets at floor level have been tried; but the inconvenience from the draught to the feet and petticoats of the workers have caused them to be invariably stopped up. The least objection is found when placed in an upper story with other machinery beneath; the greater elevation from the ground, together with the slight movement of the atmosphere caused by the motion of the machinery beneath, appear to imperceptibly penetrate through the floor and help to supply a current which feeds the powerful extracting fans generally used.

The process of weaving into cloth the yarn made in the spinning mill is generally carried on in one-story buildings, lit from the top by skylights facing the north: the temperature in summer is the normal one, and in winter is usually about 60° for ordinary weaving, and where heavy sizing is used varying from an average of 60° in some sheds to 70° in others; and the percentage of saturation by steam in these works also varies from 77° to 88°, and from 3·3 grains to 7 grains of moisture per cubic foot of space.*

An escape for air is usually provided near the ridge of each roof, but this is generally blocked up the first winter and rarely re-opened.

The practice of steaming the sheds—now prevalent in some districts and special branches of the trade, so that the weaving can be more easily done in heavy sized goods—has attracted so much attention, and has been so fully discussed elsewhere, that I need not now bring it under your notice.

The question of flooring is one of importance, especially in the mule-spinning rooms, where, from the heat averaging 80° at least, and the active movements required in piecing-up the broken threads, the workers have their feet bare. In these

* Heavy Sizing Report, 1st Oct., 1883, p. 4.

rooms boarding is generally used, and is much the best; in some cases tiling has been adopted, and also concrete floors faced with cement. To both the last named there are serious objections, as the cold surface causes both rheumatism in the lower limbs and the disease of flat foot, affecting the muscles of the instep: the want of the slight elasticity found in a boarded floor makes the labour much more exhausting, and increases the loss of time from sickness. The passage, for general traffic and skips or boxes of materials, alongside the spinning rooms, is often laid with flags, and in these cases the workers sometimes complain that the change from the warm boards to the colder surface of the stone flag, whilst the feet are bare, strikes a rheumatic chill up the legs. The passages are much better laid with hard wood in narrow widths, laid with the length of the wood at right angles to the line of traffic, so as to diminish any risk of splinters entering the foot. In the cooler rooms and on the ground floors the workers are generally shod, and no inconvenience is felt from the floor being flagged or tiled; more particularly as special precautions are taken to keep them perfectly free from damp, which would affect the carding engines and other machinery.

In weaving sheds there has long been an idea that the flags should be bedded on sand laid on clay or earth; in this respect following the idea of the old hand-loom weaver, who generally preferred his floor, where practicable, to be of well-trodden clay. The conditions of power-loom weaving are, however, so different, that the same rule does not apply, and there is said to be much less sickness where the flagging has been placed on a good deep layer of dry ballast; and this should always be done.

In many of the American mills the main passages in the rooms are washed once a week, and the other portions of the floor at frequent intervals; this is done at the request of the Insurance Companies to prevent any accumulation of fluff or dust on the floors, which is also regularly removed from all pipes, &c. The result is to make the rooms much sweeter and the floors much cleaner, more sightly and healthy; and the adoption of such a rule in English mills would be a great improvement.

Whilst speaking of American mills it may also be named here that in "the American mills wardrobes, with separate compartments, are provided for the clothes of the workpeople, who are allowed 15 minutes 'fixing time' before the machinery is stopped. The American mill hands are very well dressed outside."*

* J. B. Gass, Godwin Bursary Report, 1885, p. 19.

It is supposed that an eye is kept on the work during this time, but there will be a liability to some loss both in quantity and quality of work from this practice, which will be however of such immense value in other ways as to be well worth consideration for partial adoption here.

The water closets, or other arrangement for disposal of excreta, naturally claim the next place in the matters to be brought before you.

In many manufactories where the workshops are mainly on the ground floor, and only males employed, the system of the common privy placed in blocks of five or six, with a cesspool to same, is still used; and with the object of deterring loiterers, they are kept as plain as possible, and uncomfortable rather than otherwise. These are however being gradually superseded by those built of salt or other glazed bricks, and fitted with water-closets similar in construction to such as are afterwards referred to.

Where the works are carried on in buildings of several stories, closets are generally provided on each floor, and arranged in tiers in a projecting block forming an external pier.

The old provision for these was similar to that said to be, until the last few years, universal in French and other foreign hotels, viz.: an upright pipe of iron or socketted earthenware secured to the wall, and having obtuse-angled branches with hoppers and seats; the excreta falling by gravitation and the occasional assistance of a bucket of water to the foot of the upright pipe, and thence by a short elbow making its way into a cesspool. I am glad to say that I do not, personally, know of a single instance of this system remaining in use in this district.

Various causes retarded the use of water-closets in factories, as there is not only the question of the expense of water, but of repairs where there is the slightest possibility of a closet being thrown out of order by use or carelessness.

I believe earthenware hopper closets, fitted with lead or earthenware traps, and fixed in wooden framing, were next introduced, and these, in many cases, were prepared to discharge from the cistern by self-acting levers, moved by the weight of the body on the seat. Objections were felt to these on account of their liability to be thrown out of order, the quantity of water consumed, and the waste of the material used in the manufacture, and which there were no means of checking or detecting.

Trough closets, let off at certain hours by an attendant, as manufactured by some of the Scotch firms and others, were introduced to meet these objections, and came into extensive use.

Being made of iron they however soon became very foul and offensive, and this led to the manufacture of them in earthenware, and various slight improvements have been adopted.

The closets of this class are generally re-charged by a self-acting ball tap, and these are soon out of order; in addition to which, if a piece of paper or any other matter lodged on the seat of the outlet valve, a leakage took place, which led to a waste of water: from these causes the ball taps have been in many cases taken out, and ordinary taps substituted, by which the attendant charges the trough at his periodical visit.

The latest closets are of earthenware, in the various forms made, and discharged by automatic syphon flushing apparatus. In some cases where the water supply is obtained at the cost of pumping only, improved forms of hopper closet, with trap combined, and discharged by the weight of the body on the seat, are again being introduced.

The question of the form of aperture in the closet seat may seem trivial, but is really of some importance where, as in factories, the closets are to be used by a number of persons, any one of whom, if uncleanly in habit, or suffering from infectious diseases, may cause, in the first case annoyance and inconvenience, and in the latter case serious dangers to others, who may thus innocently be subject to grievous penalties.

The ordinary shape is adapted to the form of closet, but is generally too short. Where trough closets are used opportunity is afforded to make the aperture a longer oblong, with rounded front, instead of the ordinary slightly oval form. By this means the back of the closet seat is less liable to be fouled by an uncleanly person, and the front is less likely to be infected in the case of its being used by a person suffering from venereal or other similar disease.

It may be noted here that, as in all cases closets are rarely inspected, it is desirable to make them give as little harbourage for dirt in corners and elsewhere as possible; that they should, for the same reason, be well lighted, and the lower portion of the walls either faced with glazed bricks or painted with an enamel or varnish paint, so as to be easily cleaned. Where the building is lofty the upper parts of walls are best lime-washed.

Where practicable a small ante, lighted and ventilated on each side, between the main workroom and the closet is exceedingly desirable, and though in many cases the processes of workmanship lead to a jealous exclusion of currents of cold air, the ante is valuable in such cases also. The upper part of door to such ante may be glazed in all cases, and so assist in preventing it being a harbour for loiterers, into the difficulties of dealing with whom I do not propose to enter.

It is often most convenient, especially in towns, to supply the closets with water purchased by meter from the local authorities, and the desire to reduce this expense leads generally to very defective flushing; and as the discharges, when under the care of an attendant or by automatic action, generally take place consecutively, if not simultaneously, there are large masses of solid matter thrown into the drains at one time, and the slight flush not being able to carry them far forward, the public sewers in the neighbourhood of large works are apt to become elongated cesspools. In such cases the noxious stenches and gases evolved are very perceptible at the manholes in the public streets, and often penetrate dwellings, to the serious injury of the inmates.

I believe we are not free from instances of this kind in our own district any more than other localities, and it would be well if the local authorities, either insisted upon efficient flushing or, in such cases, required the provision of well-ventilated cesspools for the retention of the solid matter, and which should be cleansed, when needed, by them. The factory chimney may often be available to form an active current from such places, and might be made available often for sewage ventilation generally, if in the thick walls of the lower portion flues were carried up from which, when the current had been raised to the temperature of the chimney, vents might be opened to the inside near the top of the stack.

Soil pipes are generally carried up full bore to the highest point as a ventilator and fitted with some form of hood, but the provision of inlet near the base to insure a current through same is not always attended to. Where practicable it is exceedingly beneficial to carry a branch pipe $\frac{1}{2}$ in. or $\frac{3}{4}$ in. bore, from a nozzle specially provided under the closet seat and above the overflow line, the branches being connected to a main, increasing from $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. or 2 in. bore, the end of which terminates in a furnace flue or tall chimney; in this way any offensive smells from the excreta in the hopper or trough is drawn off by a strong current, the closet is also ventilated, and the odour is less likely to penetrate into the workroom.

The requirements of water-supply for drinking purposes vary so greatly, according to the temperature of the rooms and nature of the work, that I can only say generally that it is exceedingly desirable that there should be an efficient supply of good drinking water, and that in all cases there should be ample provision for washing the hands, &c. The fittings for these are best in all cases, and most cleanly looking, of cream-coloured glazed earthenware.

In the majority of cases cotton-workers live near the mill or shed at which they are employed, but in some instances the

distances are too great for them to go home for meals, especially for breakfast, for which less time is allowed than for dinner. In all such cases where other provision cannot readily be found, good airy and well warmed rooms should be provided on the works, and fitted with suitable plain strong tables and seats, and kept thoroughly clean ; ample provision should be made for washing the hands and face, and every facility given for the cultivation of cleanly and decent habits.

The Government regulations under the Factory and Workshops Act, 1878, and which by an Order of 17th March, 1880, were extended to non-textile factories and workshops, provide as follows :—

"For the purpose of securing the observance of the requirements of this Act as to cleanliness in every factory and workshop, all the inside walls of the rooms of a factory or workshop, and all the ceilings or tops of such rooms (whether such walls, ceilings, or tops be plastered or not), and all the passages and staircases of a factory or workshop, if they have not been painted with oil or varnished once at least within seven years, shall be lime-washed once at least within every fourteen months, to date from the period when last lime-washed; and if they have been so painted and varnished, shall be washed with hot water and soap once at least within every fourteen months, to date from the period when last washed."

It is evident from these that the lime-washing will be the most convenient to do in factories, and such is almost universally the case, and on the whole is carefully carried out. There are, however, instances in which it is very perfunctorily performed, and only the flats of the ceiling and sides of the beams visible from the door of the room are done annually with the hope that these will pass the glance of H. M. Inspector, who, it is needless to say, when the same is detected enforces a due performance of the regulations.

In conclusion, it is perhaps needful to say that it seemed more appropriate to the occasion and place of meeting, as well as probably more useful, to deal with one special class of works rather than to refer slightly to the large number of facts and special trade novelties which the extensive nature of the general area and range of inventions would allow.

I fear that this may have caused the paper to be less interesting and generally attractive than otherwise, but hope that it may, by calling attention to the special field of observation, be nevertheless of some service to the community among which I dwell.

Prof. T. Hayter Lewis, F.S.A. (London), remarked that the paper just read must be extremely interesting in a district such as this, and coming from a gentleman so thoroughly acquainted with the different kinds of works about Bolton. His (the President's) own knowledge of the district was insufficient to allow him to make any detailed observations on the subject. Mr. Bradshaw had gone very fully into details, *e.g.*, the difficulty of getting ventilation without draughts. They found over and over again in their experience, that whenever openings had been made for ventilation, they were stopped up by the persons who used the rooms. How this difficulty was to be got over was not made quite clear in Mr. Bradshaw's paper. Mr. Bradshaw had alluded in his paper to the subject of cleanliness, and made it one of his great points, and upon this they could all thoroughly agree with him. Without cleanliness there could be no cheerful home, and scarcely could there be a healthy one.

Mr. E. C. Robins, F.S.A., F.R.I.B.A. (London), said that in opening the discussion he might inform the section that he had received that morning various papers from the veteran philanthropist, Mr. Edwin Chadwick, who took a great interest in the proceedings of the Congress. Especially applicable to this section was a paper (much too long to be read, but which would doubtless appear in the Transactions), which happened to be on a subject quite in harmony with that which they were now discussing; it was entitled "*Ventilation of air from superior layers in place of inferior layers.*" The suggestions in the paper were not uncommon to many of them, and were simply directed to enforce the condition that the incoming air should be taken from a higher level, rather than from the surface of the ground, which was most usual, in connection with which he gave illustrative instances of an interesting character from various parts of the world. Mr. Robins proceeded to observe that in providing for the ventilation of rooms the inlets for fresh air were as important as the outlets for foul air, and that in their arrangements for bringing in the fresh air architects should be careful to know what were the circumstances affecting the quality of the atmosphere surrounding the building. At the University College laboratories at Dundee the air was brought in from the upper part of the building by a descending shaft, from which fresh air was admitted to the lower part of the building, and was then brought in under pressure. There were many buildings in which the same method had been adopted. But he had a strong objection to the use of long flues for the introduction of air, because they could not be got at for the purpose of cleaning, and had a tendency to accumulate impurities. To bring fresh air from the upper part of a building by tubes, and then to pass it through flues in the walls, was not he thought a desirable thing. His opinion was in favour of letting every room have its air brought directly in through external gratings, communicating with coil cases, within which the heating pipes could be so arranged that the fresh air might be warmed as it passed into the

room in winter time. Such a system was certain to act if arrangements were made to extract the foul air by artificial means, and so change the air at least four times in the hour. The sucking out of the foul air necessitates its replacement by purer air, and the introduction of vertical air currents well distributed eliminated draughts.

Mr. A. E. Eccles (Chorley) had been connected with cotton mills for forty years, and had taken some interest in ventilation. His opinion was that the *greatest amount* of ventilation could be obtained when the workers were absent from the mills, either during the night or their meal hours. One of the reasons why workpeople would not have ventilators open was because a sufficient number of them to be efficient was not placed in the mills. Something like the case in that room in which they were at present assembled. There were four windows in that room, but only one was opened; now if all the four windows on one side were opened the velocity of the air would only be one-fourth of what it was with one opened. In his opinion it was high time they had a change in the matter of the ventilation of their public buildings. It was certain they could not get any purer air inside than that which was to be obtained outside public buildings, and they had better have a little soot fall amongst their furniture than have their lungs filled with carbonic acid gas. In his district they had followed the system of ventilating the factory and school when the people were out, and they had derived from it great advantages.

Prof. H. Robinson, M.Inst.C.E. (London), thought it ought not to be taken for granted that dust and dirt could not be removed from air. The very best remedy was to introduce a layer of wool into a Tobin or other tube which conveyed the fresh air from the outside. He did not think it was desirable they should have the dust from the outside brought into the room at all, when by very simple methods they could remove it by screening the matters in suspension from the external air prior to its introduction.

Mr. John Leach (Bolton) did not wish to say much with regard to the ventilation of factories. He wished rather to direct attention to school buildings. The Board of which he was chairman had just completed the erection of a new school in the borough, and they had been rather exercised to know in what way they might best promote the ventilation of that building. After considerable investigation, they had come to the conclusion that the best means was to admit air by Tobin tubes, or some similar apparatus, and then have upright shafts, with an opening into each room supplied with a Bunsen's burner to create a draught, and to remove by that means the foul air from the several parts of the building. In schools containing a thousand children, where the surroundings of many of them were not of the pleasantest, and the children's clothes not of the sweetest, they required an amount of ventilatien and fresh air which he thought was greater than that required in factories. He thought it was highly important that the surroundings of these children should be as

healthy as possible, and he should hail with satisfaction the adoption of some system of ventilation at once simple, inexpensive, and automatic. The Board were recommended to try a great many systems. Some said it was sufficient if they provided for the supply of air, and not for its exit; whilst others provided for its exit, and not for its entrance. In others which were mentioned they required a gas engine and appliances of various kinds, working archimedean screws, and other systems for expelling the foul air. He should, however, be very glad indeed if that section could assist them in arriving at some effective means of ventilating these difficult buildings.

Mr. N. Simmons (Bristol) said the gentleman who read the paper appeared to have some difficulty in keeping out the soot, but he thought this difficulty could be met by cotton filters. He had seen them used in many cases with very great advantage. He had had some experience in the ventilation of schools and other places, and he had invariably found the Sherringham system to be very useful. They could put them at any height they thought fit—generally above the head. By that means they could get a lateral pressure, and could regulate the supply just as they desired by partly opening or closing the aperture on the opposite side. That system was well known, and was described in "Galton's Healthy Dwellings."

Mr. Norbury (Leigh) thought Mr. Bradshaw had very wisely confined his remarks to one particular kind of ventilation—the ventilation of factories and workshops. The paper was an excellent one, and dealt with everything that could be said on the subject. He had had some experience in the ventilation of mills, being an inspector. Mr. Bradshaw anticipated the greatest defect there was about the whole thing when he referred to the privies, and reprobated the old system. Mr. Bradshaw seemed to be very hopeful that the old system was very rare. He himself only wished that hope were well founded, but as a matter of fact it was not well founded. Mr. Bradshaw had probably mainly to do with new mills, and he had no doubt that in the mills Mr. Bradshaw erected proper means were taken to prevent the difficulty to which he would refer. In many of the old mills and weaving sheds he knew that a villainous system of privies connected with sewers existed, and these privies being usually placed in a cool place, and the atmosphere of the mill becoming heated to a very high degree, the air they really got in the mills actually came from the closets, and through what Mr. Bradshaw had well described as an elongated cesspool.

Mr. J. Honeyman, F.R.I.B.A. (Glasgow), said one of the difficulties of ventilation pointed out by Mr. Bradshaw in the case of these mills was the necessity of keeping up the heat of the atmosphere. That considerably complicated the matter, but he thought it pointed to this, that the extraction of air should be from the floor line. If they extracted the air from the upper part of the room they of course got rid of the bad air, but they wasted heat. They might, however, maintain

a very high temperature and effect the necessary removal of air if they extracted from the floor level. As to water closets, he had long had the idea that those for mills, railway stations, and similar places to which large numbers have access, ought to have no seats at all. It was quite an easy matter to make an adaptation of basin which with a movable bar could be quite as easily used the one way as the other. He thought this of considerable importance.

Mr. Rogers Field, M.Inst.C.E. (London), expressed his appreciation of the value of the paper read by Mr. Bradshaw. It was of great importance in dealing with this question of ventilation by artificial means that they should know the relative value of the various appliances for moving air. In the Exhibition which had just been opened they had fortunately a goodly number of ventilating fans and similar appliances, and the members of the Congress might see them working as it were side by side. These appliances would, moreover, be practically tested in London before the awards of the Judges were made, and the results of these tests would doubtless be very valuable to those who, like a previous speaker, were seeking for a settlement of the best means of securing ventilation for schools, &c.

Mr. E. C. Robins, F.S.A. (London), said that where there was no engine or apparatus giving motive power such as would turn a fan, they required some simple automatic method. He had had some personal experience in regard to the use of Tobin's ventilators, by which it was sought to introduce air in such a manner that it should not at once move laterally, but should rise vertically and gradually disperse itself. This was the main merit of Tobin's tubes, of which, by the way, Mr. Tobin was not the original inventor, for as he had shown elsewhere the invention was really about a hundred years old. However, the system was very useful, and he had seen it carried out with great benefit in the ophthalmic ward of St. George's Hospital. In this room there were about eight or ten of these ventilators admitting the air, and though there was no other outlet than the fireplace, and the patients, whose diseases made them especially sensitive to a draught, were sitting round the fire, yet there was a general feeling of comfort, and certainly no draught, the air rising from the ventilators and passing slowly up to the ceiling and down to the floor in circular waves until the extracting fire was reached. Certainly in that room the ventilation was eminently successful, but he knew many others in which it was not. Where this method was adopted, and they had no fireplace, or at least no fire in it, they might adopt the system of having outlet gratings to vertical flues in the walls to carry off the vitiated air, aspirated by a gas-jet at the bottom. He had himself tried the system in wards and in school dormitories. The gas might be so applied as to serve the double purpose of causing the up draught and lighting the room at the same time. If they had not this gas jet burning they might find that a down draught instead of an up draught existed in the so-called extract flues. Where there

was a heating apparatus, they might use coils of pipes both in the inlet and outlet shafts. On this principle he had himself heated and ventilated the North London Collegiate School for Girls. The fresh air was introduced and the bad air extracted by means of coils of hot water pipes in the inlet and outlet flues. In the great hall there were openings in the ceilings, and the vitiated air was conducted to each end of the triangular space in the apex of the roof, whence it was discharged through large vertical air shafts rising some distance above the ridge, at the base of which shafts hot water coils were placed, and kept heated both in winter and in summer by a special boiler. In the great hall there were often seven or eight hundred people who had almost perfect immunity from bad air or draught. A similar arrangement had been adopted by himself at the Society of Arts. In that case there was a shaft three feet square going from the basement to the top of the building, and immediately adjoining the hall. He placed at the top of that shaft a coil of pipes, and he connected the ceiling ventilators by zinc tubes through the roof with this shaft, and thus drew out all the bad air. The fresh air was admitted to the room through five openings fitted with canvas screens, the air from which passed over heating pipes, and was delivered into the hall through horizontal gratings the whole length of one side of the hall. It was very desirable that an investigation should be made as to the value of the different fans in the present exhibition, because he had had to take fans out which were found to be unsuitable, either on account of their noise in working, or failure to withdraw a sufficient volume of air. The shaft on the delivery side of the fan should be as wide and open as possible to give free scope for the expulsion of the air, and the more direct the action the better—every right angular turn in the channels halved the force of the extracting current.

Mr. Tom Nanson (London) thought there was a point in Mr. Bradshaw's very able paper which had quite been lost sight of, that was: that it was not only necessary to introduce fresh air at a certain temperature, but that it should also be introduced with a certain percentage of moisture. He thought that this could be attained by passing it over a trough of steaming water. It would be at once seen that if the air was sent into an air chamber, and then deflected over this trough of steaming water, there could not be brought in with the moistened air those sooty particles which had been complained of. Then they had heard several remarks about fans, but Mr. Bradshaw had clearly shown the necessity of changing the air with the least possible motion, and in his (Mr. Nanson's) opinion, the use of fans would create such a considerable agitation of the air as to render their use impracticable. Why should they not have the air brought in by a series of trunks and comparatively small ventilators? They would only have to increase the number in exact ratio with the size of the room they wanted to ventilate. He had not the same objection to the trunk and chamber system that Mr. Robins

had. It had been said, and he was sure that Mr. Rogers Field would agree with him on this point, that it was possible to keep a drain as clean as a drinking jug, if they only took pains with it; and the keeping of those trunks clean was simply a matter of detail in construction. By a system of doors they could be cleaned out weekly, though he did not think it would be necessary to clean them out more than monthly. As to the filtration theory, he thought the cotton filter was practically out of the question. In a cotton factory they would have to clean these cotton filters twice a day, or they would get clogged up. And with regard to the removal of the foul air, he thought it should be attained by the ordinary fixed induced-current ventilators.

Mr. T. Connolly said that he thought one point appeared to be very often lost sight of: the tubes were frequently too large and wide and too few, so that they got a strong current from each inlet, producing a very disagreeable draught. In his opinion they ought to be very long and very narrow, not more than an inch in depth. They believed in having the walls and floors cemented, and in this case there was no danger whatever of getting in any impurity through the soil. The air being pumped into the chamber room was therefore under pressure, so that there was no chance of air from the outside permeating into the room. With regard to cotton filtering, had it not been found by persons of practical experience that where utilised it interfered very materially with the current?

Mr. Herbert Fletcher (Bolton) said he had made practical application of cotton filtering, though not in a cotton mill, but in his own house. He kept a window open in the cellar, and fixed in front of it a large frame, over which he threw a calico bag about six feet square, entirely covering the window; the air in passing through the bag left a large portion of its impurities on the inner side of the bag. The bag soon became very dirty, but was ready for use again after washing. His house was within the Borough. The texture of the calico was coarse, but the "nap" was "raised" by some process in the mill. Mr. Fletcher concluded by inviting the members to his colliery, where they might see the boilers hard fired, yet emitting no smoke, and have the opportunity of descending a mine where the subject of ventilation is necessarily the first to which the attention of the management is always directed.

Mr. Leach (Bolton) said that it had been remarked that in a London Hospital the ventilation was produced satisfactorily by means of Tobin's tubes around the room. He wished to ask whether the Tobin's tubes were on two sides of the room only, or otherwise.

Mr. E. C. Robins, F.S.A. (London), said in reply, that the room in question was square, and as far as he could remember there were three tubes on each side — perhaps twelve altogether; he also

remarked that canvas tops to the tubes were of little use unless often examined and cleaned. They were, however, very effectual in keeping out blacks, but the Æolus Water-spray was a better plan for that purpose.

Mr. Darley (Leeds) pointed out that Mr. Bradshaw had headed his paper "Sanitary Apparatus for Convenience in Factories." Hospitals and schools had been introduced into the discussion, whereas the subject under deliberation was factories. Mr. Bradshaw wished it to be understood that he was not pushing some speciality in connection with sanitary apparatus for the convenience of factories. No one supposed he was. If, however, there were any special system, he should be very glad to know it, and would like to have it put before the meeting. Ventilation was a problem which the greatest men of the day considered unsolved. There was an important factor which had not been touched upon—except by Mr. Bradshaw—that day, viz., varying climate. A fall in the temperature of ten degrees was not an uncommon thing, but was one which would create a great difficulty in keeping up the temperature of the factory and maintaining a thorough ventilation. One of the principal reasons why people closed the inlets was because they would be warm, and therefore they got one benefit at the sacrifice of another. There was a great difficulty in creating and keeping up the temperature and at the same time giving the quantity of air requisite for ventilation. Turning to the question of factory closets, he would like to know whether there were any closets and drains ventilated by chimney shafts. His experience taught him that they were more the exception than the rule, for the simple reason that a number of chimney shafts were built of insufficient capacity for the duties they had to perform in connection with ordinary steam boilers. If such chimneys were called upon to also ventilate closets, it would be found to reduce the draught in the boilers, and thus create a difficulty in maintaining steam. In conclusion, he trusted they would get from Mr. Bradshaw some definite answer on the subject of the particular system of ventilation he recommended.

Mr. E. Sergeant (Bolton) said the practical experience of ventilation he had had was in connection with that at the fever hospital in Bolton. They had recognized the great difficulty that existed in regard to ventilation, and were satisfied that in order to have it efficient, it should be as free as possible from any mechanical contrivance that was liable to get out of order. He thought they had succeeded fairly satisfactorily. They had had ventilators introduced whereby the wards might be kept at a proper temperature in winter and made cool in summer without cold air being directly introduced. There was a special sort of catch-pit underneath the ground which caught the air from the outside and then it was passed along troughs running round the wards, and having been heated was introduced under each bed, and by means of shafts conveyed over each of them

at a distance of about six feet from the ground; inside the top of each shaft they had, in a movable drawer, a sort of diaphragm with a covering of worsted which intercepted the dust and any objectionable particles. Thus the air was introduced warm, free from dust, and so as to obviate any draught; these were conditions he thought they ought always to aim at. They had also in their wards an arrangement which he thought was highly essential for removing burnt gas, which they considered very deleterious to the health of people in a hospital. They had a special arrangement which he thought was worth looking at: it was in the shape of a cap over each gas bracket, which was so arranged that the burnt gas was conducted by means of a tube an inch and a half in diameter through the ceiling, and so passed out of the room by means of the ventilators. If the current was not satisfactory they were able to rectify it, and so at all times to take away from the wards the burnt gas which was so prejudicial in living rooms. They were also able to collect the foul air from the wards and withdraw it by means of the current induced by the hot air through the ventilators. In conclusion, the doctor invited those members of the section so disposed to visit the hospital that afternoon, where he could more clearly explain the methods of ventilation.

Mr. J. J. Bradshaw (Bolton), in replying, said he did not wish to extend the time by entering into the general question of ventilation. He pointed out that in a room 20 ft. by 16 ft. by 12 ft., which contained about 4,000 cubic feet of space, the Tobin tubes were often closed. The rooms in the Bolton Town Hall were ventilated by their means, and the clerks complained strongly of the draught when the wind was in the direction of the tubes. The wind came in with great force, and they were often stopped up with books or something of that sort. This showed the difficulty of ventilation in a small room: but increase the area of that apartment from 4,000 cubic feet to 800,000 cubic feet, and what a difference that would make. Added to this, they had a fibre to manipulate which was as sensitive as a thermometer, and which under given conditions they could not work at all because it would drop off. Under all circumstances the ordinary expedients of filtering the air by folds of cotton wool, or anything of that sort, became totally unapplicable, because the work had to be done on so large a scale, and all the time they had to bear in mind the delicacy of the material upon which they were working. Fresh air, admitted as it frequently was by direct, or slightly indirect, inlets from the atmosphere, meant to the manufacturers increased coal consumption in the winter, because the temperature of the room must be maintained to avoid damage to the material. He was not recommending any special system of ventilation because, to tell the truth, he did not know of anything that answered the purpose absolutely well. He had plans of his own, but he had not brought them before the meeting for the simple reason that he had not given them a successful trial on the scale required for buildings of that class. The varying temperature of the atmosphere, and the necessity of preventing draughts—which was a

thing common to all systems of ventilation on either a small or large scale—were difficulties that seemed too great to overcome in old buildings: he thought he could see his way to achieve it in new buildings, where a special provision could be made. Manufacturers, in erecting a large mill, were generally compelled, from prudential reasons, to regulate every penny of their expenditure: if an expenditure of some hundreds of pounds were proposed, the manufacturer wanted to know what he was to get in return for it, and to see an example of the contrivance in actual operation. They were all willing for some one else to "bell the cat." This was one of the difficulties they had to overcome. He knew of no scheme that could be applied to existing buildings with a guarantee of perfectly satisfactory results. That was a reason why he did not name anything of that kind and bring it before the conference. Mr. Norbury's observations might apply to other buildings, but not to the cotton mills of Leigh. With regard to Mr. Honeyman's remarks, he was sure that that gentleman had never worked in a cotton mill, or he would not have made the proposal he did with regard to closets in cotton mills. After people had been employed five or six hours he thought there ought to be some reasonable provision for comfort, and that at the same time every precaution should be taken to prevent the possibility of annoyance or danger arising from it.

Prof. T. Hayter Lewis, F.S.A., remarked that there was no fear of any one considering Mr. Bradshaw's paper anything but interesting. It had brought about a valuable discussion, and personally he was much indebted to him.

On "Village Water Supply," by Stephen Harding Terry, Assoc.Mem.Inst.C.E.

The excessive drought of the present summer is causing many who have hitherto either never considered the subject of this paper, or who have obstructed the progress of a water scheme, to look upon it as a necessity, and one which must now be dealt with.

Having been brought more or less intimately in contact with many of the difficulties which arise in connection with the supply of water in rural districts, I venture to think that this paper may not be without interest; and I propose to show that the cost, which is the real deterrent in connection with the adoption of a water scheme, is in most cases (if a qualified

engineer is consulted) far less than is generally believed, and that in many instances where a gravitation scheme not involving the cost of a large reservoir or great length of mains is adopted, it is found that a small water rate, not exceeding 2d. or 3d. per week per house, is more than sufficient to pay for the whole cost, if the works have been constructed by means of a loan repayable in equal annual instalments of principal and interest.

I propose to give examples of various methods of supply :—

No. 1. Gravitation.
No. 2. Pumping.
No. 3. Arrangement with Water Company or adjacent authority possessing water.
No. 4. Draw-wells and Hand-pumps.

No. 1.—*Gravitation.*

The village of Tansley, near Matlock, is an instance of the first method of supply.

The population is 678 ; rateable value, £2,069.

Prior to the completion of these works in 1885, the village was entirely without any proper means of water supply, and was dependent on certain surface-fed springs, which failed in dry weather and were subject to pollution; there are also certain small streams flowing through the village, but these are polluted.

Messrs. Fowler and Sons, of Sheffield, designed the following scheme, which was successfully carried out by Messrs. Thompson, contractors, of Sheffield :—

Two underground reservoirs, of a total capacity of 4,200 gallons, receive water from two springs having an average flow of 36,000 gallons in twenty-four hours. Stoneware pipes bring the water to the reservoirs, which are kept constantly full, the overflow passing into the original channel of the brook. The pipes are cast iron, three inches diameter, and were tested to 600 lbs. per inch; the greatest head is 180 feet. Eighteen stand-pipes with screw-down cocks, and three fire-hydrants are provided. Some houses have the water laid on free of charge, except for the cost of connecting the service-pipes. The work is done by the authority, and repaid by the house owner. The actual cost of the works, giving a constant supply (up to fifty gallons per head, if necessary) to 678 people, has been £700, the annual instalment of which, principal and interest, at 3½ per cent. for thirty years, is £38 1s. 3d., or 4s. 4d. in the pound on the whole rateable value, or about 1s. 2d. per head per annum ; or, assuming that there are 114 houses, a water-rate

of 6s. 8d. per annum, or just over 1½d. per house per week, would entirely relieve the general rates of all charge. The capital cost of the works per head of population has been £1 0s. 7½d., a sum which compares favourably with the cost of supply of most large towns.

Below is given a typical estimate of cost of works of supply by gravitation for two villages situate in Gloucester and Wiltshire. It will be noted that 120 houses, with a population of 560, are supplied at a capital expenditure of £1,200, and that the total cost at 4 per cent., repayable in thirty years, amounts to £69 8s. per annum. The revenue at an average of 3d. per week per house, including farm-houses, is £78, showing a balance of £8 to meet expenses of collection.

There are 5¾ miles of main and service pipes; and as the spring is to be depended on both in summer and winter, a large storage reservoir is not required.

	£	s.	d.
3 miles cast iron main 3 in. diameter, at 2s. per yard laid	528	0	0
1 mile of 2 in.	165	0	0
¾ „ 1 in.	63	15	0
1 „ ¾ in.	65	0	0
Draw-off cocks, stand posts, air valves, &c.	78	5	0
Reservoir, valves, &c.	100	0	0
Engineer's commission and contingencies, 15 °/₀	150	0	0
	1,150	0	0

Or in round figures say £1,200 for the supply of those parts of both villages which are now without drinkable water.

The annual repayment on £1,200 at 4 per cent. for 30 years is £69 8s. 0d.; an equal rate on the whole rateable value £18,303, would require to be ·9d. in the £ supposing no special water rate was levied.

Assuming that 120 houses in the two villages are supplied at an average rate, including farm-houses, of 3d. per week, a gross revenue of £78 per annum will be obtained; which will be more than sufficient to pay the entire cost of the loan, and will leave a margin of £8 to meet the expenses of collection.

No. 2.—Pumping.

At present very few villages are supplied from waterworks of their own by pumps worked by steam power, but this system of supply is in many cases the only one possible, and with the production of economical and simple motors, such as those of Davey, of Leeds, is likely to greatly extend.

A village in one of the midland counties is now constructing

waterworks of this character, under the advice of Mr. Herbert Walker, of Nottingham. The population is about 1,000 and the works will cost about £1,200. The reservoir will hold about four days' supply or more, and the pumps will raise in one day enough for four days, so that it will only be necessary to run the engine and pumps twice weekly. In this way the charge for superintendence will be lessened. The capital cost per head of population will be £1 4s.

	£	s.	d.
The annual instalment of principal and interest at $3\frac{1}{2}$ per cent. for 30 years will be...............	65	0	0
Assuming coals and supervision to cost*	35	0	0
	100	0	0

Assuming that 180 cottages at 3d. per week take the water, there will be a revenue of £112 10s., leaving a balance of £12 10s. towards repairs and contingencies.

It is remarkable that in this country windmills are so little used for public water supply in villages. They are largely used in America for supplying water on railways for locomotives and station purposes, and if the reservoir filled by them is large enough to contain a week's supply they give very satisfactory results. Small sizes have been in use some years in this country for supplying private houses and farms, and I have recently seen, near Rickmansworth, a large Halliday windmill, with fan 25 feet in diameter, mounted on a platform 80 feet high, which raises water from a deep well against a total head of 180 feet. It supplies a mansion, farm buildings, and stabling, together with a large horticultural establishment, and I understand it gives complete satisfaction, keeping the reservoir always sufficiently full. I have no means of knowing the volume pumped, as the speed varies continually and no water meter is attached.

The little town of Lechlade, in Gloucestershire, which for the purposes of this paper may be considered as a village, has adopted a windmill pumping scheme; the works are now under construction. Water is obtained from two Norton tube wells, and the reservoir and engine are of the Halliday type. The reservoir is a circular wooden one, and carries the framing of the mill on its top. The pump is of the Ontario type. The first cost of the wind engine and reservoir is slightly in excess of the cost of a small steam engine, pumps and reservoir, on account of the necessity of increasing the size of the reservoir

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* Arrangements are being entered into with a farmer in the parish for the use of one of his men as engine-driver twice weekly.

when wind is the power employed, to insure a supply during calm weather.

As an example of a pumping supply in a comparatively rural district, I will instance the Sutton-in-Ashfield, and Hucknall-Huthwaite Works, which were completed recently, Mr. G. Hodgson, of Loughborough, being the engineer. The Works supply a population of 11,000 people in the two towns and adjoining villages: the towns are some miles apart, have separate reservoirs and rising mains, but the same pumping station. The machinery and buildings are of a very substantial character, and the entire cost of the works has been £17,300 or £1 11s. 5d. per head of population. The well yields 1,000,000 gallons daily, but at present only some 300,000 gallons per day are required.

No. 3.—Arrangement with Water Company or adjacent authority possessing water.

As an instance of this I may mention Seend, Wilts. The whole of the lower part of the village—in which there are very few wells, and those polluted—is now supplied by agreement with the Trowbridge Water Company, who charge 1s. per 1000 gallons by meter; the rural Sanitary Authority laying mains up to the limits of supply of Trowbridge Company, the latter meeting them. The rural Sanitary Authority charge water rates for stand-pipes, and the sum thus recovered is almost sufficient to repay principal and interest on the small capital, some £250, together with cost of water.

Another instance of this is Stanks, near Cross Gates, Leeds. The rural Sanitary Authority of Barwick, in Elmet, are now completing works for the supply of this hamlet of 51 houses.

The cost is estimated at £250, or nearly £5 per house supplied; the revenue derived from water rates at 3d. per house will be more than sufficient to repay the loan in thirty years.

Hucknall-Huthwaite and Sutton-in-Ashfield, the example quoted in the heading No. 2, is an instance of arrangement with adjacent authority. The Sutton pumping station was first completed, and, the water having been found abundant, it was decided to supply Hucknall from the same source. There are throughout the country numerous instances in which an arrangement of this kind would be made to advantage, but frequently the opportunity is lost through local antagonistic feeling between the parties concerned.

No. 4.—Draw-wells and Hand-pumps.

Several villages in Suffolk and Essex have within the last few years been supplied with water by means of public wells

constructed under the Public Health Act and Public Health (Water) Act, and the cost has been defrayed by means of loans; and as the cost of any well so constructed seldom exceeds £100, and loans for a period of thirty years are sanctioned, the incidence in the rates is very small; notwithstanding this, these applications are generally met with great opposition on the part of some ratepayers living beyond the reach of the well so constructed.

In public wells, wherever possible, the well should be covered in, and the supply obtained by a pump. Where the depth of water precludes the use of a suction-pump, and a deep-well pump, on account of expense, is deemed unadvisable, some form of well-engine should be provided, with two buckets, by which the empty bucket descending partially balances the full one ascending; and in all cases of public wells a draw-bucket should be provided attached to the chain, so that the private buckets of those fetching water need never be dipped in the public well. It might be supposed that this precaution is sufficiently obvious, but it is frequently neglected. Children, or even their elders, stand buckets down in filth, and even use buckets which have recently contained filth, and then send them down a public well.

To prevent this, all that is necessary is to provide a public bucket attached to the chain, and to protect the mouth of the well, so that no water or filth near the top can pass down through the cover or sides. All wells should be lined with brick in cement for a considerable distance down; in fact, until some impervious strata is reached, to prevent the entrance of impure surface waters.

The village of Littlebury, near Saffron Walden, has signalized the jubilee year by making a boring 120 feet in depth, 116 feet of which were in chalk. The boring is lined to within a few feet of the bottom with four-inch screwed flush-jointed wrought iron pipes. Water rises to within 10 feet of the surface, and is of excellent quality. Fifty gallons per minute for eight hours consecutively pumped from it only lowered the water level a few inches, and it is intended to connect the vertical pipes with horizontal mains at a depth of about 13 feet, and from this source to supply the lower part of the village, the higher part being already supplied from the pump. The cost of the boring and pump has been £135; the work was done by Mr. Ingold, of Bishop Stortford. An unsuccessful boring was first made about 100 yards away from the present one, to a depth of 220 feet.

Many villages and towns also would have been satisfactorily supplied for less money than the present unsatisfactory schemes

have cost, if they had employed engineers instead of those who have had nothing to do with water supply.

Schemes are brought out by land surveyors, architects, and masons, and others who, however able they may be in their own professions and callings, have not had any experience in water supply. Some few years ago a proposal was put before me by which it was intended to pump the whole low-level supply of a district 20 feet higher than was necessary to supply the low level, in order to work an hydraulic ram to raise one-third of the volume an extra height of 80 feet to supply the high-level district!

It may be objected by those who unfortunately oppose the progress of sanitation, that I have not dealt with the question of acquisition of water right or compensation; this question when raised is generally too large to be dealt with satisfactorily in a short paper, but it is not too much to say that only a very short-sighted policy would offer obstructive opposition to the adequate supply of a village with one of the first necessaries of life, and in many cases the volume required is so small as to be of no use to the mill interests, although unfortunately a great point is often made of this where a local authority is treating for a supply.

There are numerous instances in which the mill interests have been greatly benefited by the construction of large storage reservoirs for public supply, as their construction has enabled a given volume of compensation water to be daily delivered to the water course during continued periods of drought, whereas without such reservoirs their water would have reached the sea weeks or even months previously in useless floods.

In conclusion, it is hoped that the figures and instances here given, and the discussion which may arise, will shew that the cost of supplying villages with water is not so great as is generally supposed, and that in many cases, where circumstances are favourable, the whole cost can fall on those who are benefited by it.

Section 64 of the Public Health Act empowers a local authority to compel an owner of a house to supply that house with water at such rates as may be in force in the district (if there is a local Act in force), or should there be no local Act, at a rate not exceeding 2d. per week, or such rate as the Local Government Board may consider reasonable. Section 9 of the Public Health (Water) Act, 1878, provides for the levying of water rates on all houses using water from stand-pipes, if such houses are within 200 feet of such stand-pipes.

The above clauses provide ample means for recovery of the cost of construction of such works as bring the supply into the

houses or to stand-posts, whether such supply is obtained by gravitation from springs or by pumping, and whether such supply be obtained by a rural Sanitary Authority, direct or by agreement with a neighbouring authority, or water company. Nothing in these sections however provides for cases in which the geological formation or altitude of houses to be supplied prevents the supply of water by means of pipes, either to stand-posts or into houses. Section 3 of the Public Health (Water) Act, 1878 (framed upon the evidence given before Mr. Alexander Browne's Committee), was intended to deal with cases in which the supply can only be obtained by draw-wells or hand-pumps; but this section has, it appears to me, not been used to the extent which might have been expected, on account of the opposition generally found in rural districts, based on the objection on the part of a ratepayer well supplied with water in one part of a parish to pay for the sinking of wells or fixing of pumps for the benefit of others, perhaps several miles distant.

It is true that the framers of the Act in question foresaw this difficulty, and apparently intended that sub-section (5) should meet it.

Sub-section (5) is as follows:

"Where the owners of two or more houses have failed to comply with the requirements of the notices served on them under this section, and the authority might under this Act execute the necessary works for providing a water supply for each house, the authority may, if it appears to them desirable, and no greater expense would be incurred thereby, execute works for the joint supply of water to those houses, and apportion the expenses as they deem just."

In Section 3 power is given to cause works to be executed (wells to be made) at a cost not exceeding £8 13s. 4d., or in certain cases £13 for each house. If water were in all cases sufficiently near the surface to enable a separate well for each house to be sunk for this sum, there would be no difficulty in recovering it by means of a rate of 2d. or 3d. per week on the property benefited. But it is precisely in such districts that a sufficiency of wells (though not necessarily pure) already exists.

It is for cases in which the wells have to be 50, 100, or more feet in depth, that the power of charging the cost on the property benefited rather than on the whole parish is desirable. At first sight nothing would appear easier than to deal with the matter as follows under sub-section (5).

Suppose there are 10 houses sufficiently near together to use one well, and that such well be made and provided with a pump, or windlass with bucket, chain, &c., at a total cost of £130.

If each house owner paid £13, or 3d. per week (Section 3), a water supply for these 10 houses would be provided at the cost of those benefiting from it, without increase of rates, or those receiving no advantage from it and dwelling perhaps miles from it. For reasons which I do not propose to discuss, sub-section (5) is not so read, the result being that works are seldom carried out under this section, a thing much to be regretted, as I believe that much of the opposition which retards, and in some cases prevents entirely, the adoption of some form of public water supply, would be withdrawn if it were possible to work under this section. I do not venture to suggest any special alteration or modification in the wording of this section, but I have drawn attention to the matter, as I believe it to be one with which the future of village water supply is closely connected.

[*For discussion on this paper see page* 254.]

On "Artesian Wells and Water Supply," by Robert Sutcliff.

The usual object of sinking an artesian well is to obtain a water supply from a pure source, uncontaminated by any surface drainage, and it is from that aspect that the subject has especial interest and importance to a body like the Sanitary Institute. Anything that facilitates the obtaining of pure water supplies is a matter of great national importance, and the object of this paper is not only to refer to the various methods of sinking wells, but also to point out the value of information bearing upon the right spots for undertaking such operations. If this be not done, a great waste of money may take place by sinking at a site where technical information could have indicated beforehand the probabilities of failure. Every abortive boring is likely to injure the enterprise of others who contemplate a similar work, although the circumstances that caused the failure may not be present in the cases of those that are so deterred. The first questions then to be considered are: What strata will have to be pierced? What depth will have to be reached, and what supply and water-level will be obtained by the well-sinking operations? These are questions to be answered by geologists, and especially by those geologists who make a study of hydrogeology. To this study

should be added the compilation of data with regard to existing borings, whether successful or the reverse. The opinions of a contractor, when based upon long and varied experience, may be of great value in assisting and supplementing the advice of the geologist; but as the contractor gets paid for work done and not for opinions, it is very desirable that skilled technical advice should be obtained at the outset. Geologists (like other mortals) are not infallible, and of course they base their opinions on evidence and knowledge that they possess. A boring may reveal a different state of things to what had been expected, due to local circumstances with which no one was previously acquainted. For this reason it is very desirable to submit samples from time to time to the advising geologist as the work progresses, should there appear anything obscure or different to what was expected. The geologist is also frequently able to express an opinion as to the character of the water that will be found, and to say whether it is likely to be a good potable water, or brackish, hard, or chalybeate. As all underground water comes more or less remotely from the surface where the waterbearing stratum outcrops, the area of outcrop, the rainfall of the district, and any probable sources of contamination have to be duly considered. All inferences and deductions as to the probable quality of the water should, however, be positively proved by analysis of samples taken directly from the boring, with the usual precautions to ensure that the samples are properly representative of the water to be examined.

The various methods of constructing wells, so far as they have a bearing on the purity of supply, may next be briefly dealt with. These methods may be roughly divided into four branches: the first and most ancient is digging; next comes boring; after which follows a combination of digging and boring; finally, there is the Tube Well system, which in certain cases dispenses with both digging and boring. To deal with these in the order given, the dug well has first to be considered. As regards cost, the digging of shallow wells under favourable circumstances is very economical, but if a great depth has to be reached and objectionable surface water excluded, the process becomes costly, and from a sanitary point of view extremely unsatisfactory. The crudest form of dug well is lined with loose bricks, not cemented in any way, and through the interstices of the brickwork the water percolates into the well. The danger of contamination in such cases is very great, and is shown very graphically by Mr. T. P. Teale, M.A., and Surgeon to the General Infirmary at Leeds, in a work entitled "Dangers to Health." Such a method of obtaining a water supply requires

no further comment, as it must meet with the condemnation of all sanitarians.

The better class of dug wells are either lined with cemented bricks or iron cylinders, and if they exclude contamination through the sides are very costly, especially if the digging has to be made through a large body of contaminated water. Such wells are also liable to contamination by the introduction of objectionable matter from the top. It will be remembered that the Caterham dug well, which caused an outbreak of typhoid fever in the district that it supplied, was polluted in a particularly disgusting and dangerous way by workmen employed in it, who used the well buckets for an improper purpose.

The well that is made by boring alone may be sanitarily good or the reverse, according to the method in which it is carried out. To deal first with the objectionable method,

FIG: 1.

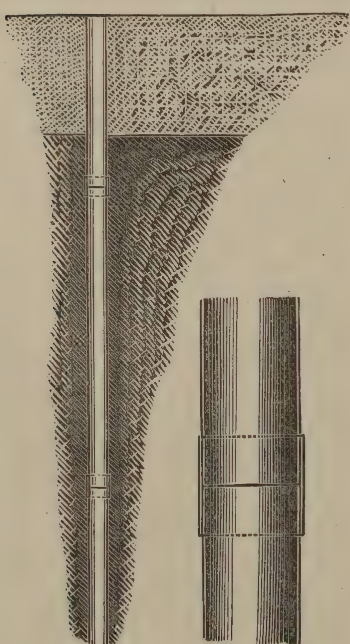
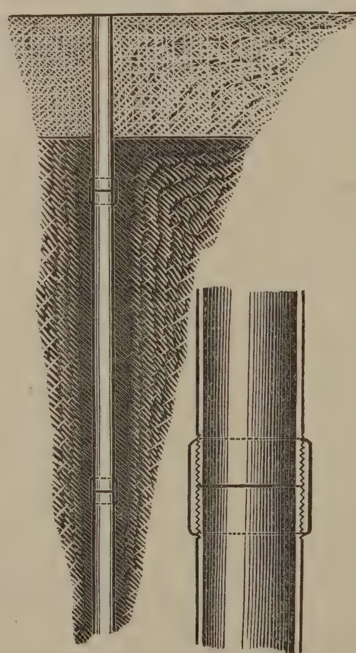


FIG: 2.



which is shown in Fig. 1, the lining tubes are what is called "telescoped," that is, one tier of pipes is dropped within the other without any proper connection between the different sizes

of pipe, and hence every point of junction is a possible source of contamination. The metal in the pipes is also thin, little better than sheet iron, and the joints are what are known as braize and collar, which is frequently not an efficient air-tight joint. Owing to their weakness, such pipes cannot be driven forcibly through the strata, and hence they fit the bore hole more or less loosely, thus allowing surface water to run down the annular space outside them. Such pipes cannot be placed in air-tight connection with the pumps. There are, therefore, four dangers in a well of such construction: contamination may get to the source of the supply outside the pipes, and through the imperfect joints, and at the point of junction between the different tiers of pipes, or actually through the iron, which is so thin that it offers very short resistance to the action of corrosion.

The combination of digging and boring affords a much safer means of obtaining a water supply if the bore pipe be properly constructed, and attached by air-tight connections to the suction of the pumps. Should this precaution not be adopted, the danger of contamination is exactly the same as in the dug well pure and simple.

The bored well that complies with sanitary principles is shown in illustration, Fig. 2.

It will be seen that the tubes are much thicker; the joints are screwed and fitted with great accuracy, so as to be not only water-tight but *air*-tight. A continuous tier of tubes goes from the pure spring to the surface. The outer and larger pipes are simply used as tools for obtaining this result, and only those that serve a useful purpose in excluding objectionable water remain permanently in the ground. The stoutness of the tubes enables them to be driven very tightly into the bore hole. Tubes of this construction are frequently subjected to 100 blows with a 1200 lb. monkey to drive them a single inch without any injury to pipes or screw threads, as the pipes accurately butt in the centre of the socket, and leave no exposed thread. The connection to the pump from the tube is air-tight, so that the spring is effectually sealed from all sources of contamination, and is delivered just as it comes in its natural state from the spring. This last mentioned method is known as the "Artesian Bored Tube Well" system. It is a development of the "Abyssinian" Tube Well system, and became necessary when strata were met with that could not be penetrated without the removal of cores. The "Abyssinian" Tube Well system is so widely known as merely to require passing mention. A pointed tube is driven forcibly into the ground until it meets with the desired water supply. The water is then drawn into

the tubes through the perforated bottom length by a pump in air-tight connection with them. This simple means is available in cases where the soil can be penetrated by mere displacement, or by fracture and displacement, without any removal of cores. As a rapid and economical means of obtaining water supplies free from surface contamination it is the most efficient known. It was awarded the Medal of the Sanitary Institute, and the Gold Medal at the Health Exhibition. At the recent water famine at Swansea it was largely brought into requisition, and by its means water was found at a depth of 40 ft. in less than two hours, which was pronounced by the public analyst to be the purest water in Swansea. The greatest depth that an "Abyssinian" Tube Well has been driven within the knowledge of the author was 157 ft., at Norwich. The largest supply of water obtained from "Abyssinian" Tube Wells is probably at Burton-on-Trent, where the large breweries draw about two million gallons daily from a number of tubes coupled to one receiver, and pumped by steam power. The time at disposal will not permit of a description of the method of pumping from a tube when the water is far below the surface, but it may be mentioned that water is drawn from a depth of from 100 to 200 ft. through tubes 4 in. and upwards in diameter.

[*This discussion applies to the two preceding papers by* Mr. Stephen Terry *and* Mr. Robert Sutcliff.]

Professor T. Hayter Lewis, F.S.A. (London), explained that he had allowed these papers to be read consecutively, because they were so closely allied that it would save time to discuss them together.

Mr. Rogers Field, M.Inst.C.E. (London), observed that he had often been struck in considering the question of water supply, that such little use was made of the windmill. Of course one could well understand that in the case of supplying a town of any considerable size it would not be advisable or economical to use wind power. The question was, however, altogether different in the case of a small village, or even a moderate sized town. The great disadvantage of a windmill was of course its uncertainty; for some time they would get a considerable amount of wind, and then for days or weeks

perhaps they would get none at all. But this was capable of being entirely met in the case of the water supply of small towns, for all they had to do was to construct a reservoir of sufficient size to hold a supply large enough to meet the demand until such time as the windmill could be got to work again, when they had at once a power for raising water which worked practically at a nominal expense. Some time ago he had to look into this question, and was anxious to see what was the necessary size of the reservoir; but he found that there was hardly any reliable information at all on the subject. He had therefore investigated the question to a certain extent for himself. The first point to ascertain was the length of time they might have to wait in this country without the wind blowing with sufficient force to work the pumping engine. In order to gain accurate information on this point he got the records of the velocity of the wind as recorded in the quarterly weather report of the Meteorological Council, and he took five different places of which there was a continuous record, and which he thought would fairly represent the difference found in the climatic conditions of the several parts of the country. Of course anyone who had paid attention to the subject knew that the velocity of the wind and the extent of calms would differ very much in different parts of the country. He took Stonyhurst, Kew, Glasgow, Greenwich, and Aberdeen. At Stonyhurst there was the least amount of wind and the greatest amount of calm, at Aberdeen there was the greatest amount of wind and the fewest calms. Before using these data he had to determine another point, about which there was the greatest possible uncertainty—viz., what is the velocity of wind which will work a windmill effectively; there was hardly anything definite known about this, but as far as he could ascertain the velocity seemed to lay between five and eight miles per hour. Dealing with these data in the best way he could, the result he arrived at was as follows: taking an ordinary case, such as that represented by Stonyhurst or Kew, they might have twenty days, or from that to thirty days, in which the windmill would practically do them no good, and therefore they might want twenty or thirty days' storage capacity. Taking on the other hand a favourable case, such as that represented by Greenwich or Aberdeen, they probably would not require more than a fortnight's storage capacity. Mr. Terry stated that in America storage capacity for a week's supply had given satisfaction, but he did not think that would meet the wants in England. If they only made a reservoir capable of holding a week's supply, they would soon find themselves running short; but if they provided a fortnight's or a month's storage capacity, then it seemed to him that wind power might be used with the greatest possible advantage in country places. There were numbers of places which could be supplied from springs or wells at a low level if the water were elevated by this means. He knew of one or two cases where large mansions were supplied in that way, and when the reservoirs were made sufficiently large the results had been advantageous. He wished also to emphasize the point made by the writer when he called attention to the necessity of having waterworks

properly designed; he knew cases where land agents and others who had no practical knowledge on the subject essayed the task of planning waterworks with the idea that money would thus be saved, whereas it was generally not so. Often a spring was chosen without any sufficient research as to what was the yield of the spring in dry weather, and a large outlay was thus incurred to very little advantage. He could instance the case of a small village where iron pipes had been laid to convey water from a spring which had not been properly investigated, and then directly a drought came they were short of water. Now no engineer would dream of going to work until he had some reliable data as to how much water could be depended upon in dry weather.

Mr. H. Law, M.Inst.C.E. (London), endorsed what had been said by Mr. Field. It was a very important matter that really healthy supplies should be obtained for the villages, but it was also important that they should bear in mind that the villages were often so small that they could not bear a large expenditure; which difficulty however might be overcome, as was pointed out in the paper, by the amalgamation of districts. But this was often a difficult matter from conflicting interests and jealousies, and therefore any practical suggestion which enabled the village to provide for its own wants in some inexpensive manner was well worthy of being considered by the profession. He felt very sure that if proper reservoirs, which could now be very cheaply constructed of concrete, were provided, the windmill pumping would in many cases form an easy and economical solution of this important question.

Mr. Page considered Mr. Terry would have done well to have added some information upon the collection and purification of roof water. In the country districts where dwellings were isolated, rain water formed a very important feature in cheap water supply; and he thought the paper would have been rendered a great deal more valuable had the storage of water from the roofs been mentioned, and some means of purifying it indicated. In travelling in country villages and districts, they must all have seen what a number of dwellings there were without any provision in the way of water supply; it was only the other day that he was investigating a rural district, and he found people actually fetching their water in buckets from a stream nearly a mile distant, of very doubtful purity. He thought some legislation ought to be carried into effect to render it absolutely necessary for owners to provide a water supply to their property. Roof water might be collected and purified cheaply in many cases.

Mr. H. Law, M.Inst.C.E. (London), observed that in the large and important city of Buenos Ayres, in South America, the people depended almost entirely for their water supply upon a large underground tank, which was constructed in the centre of the court of most of their residences, and it was hardly ever known to fail. He knew cases in the neighbourhood of London where water for drinking

purposes was supplied by collecting rain water, which only required filtering to become pleasant for drinking purposes.

Prof. T. Hayter Lewis, F.S.A. (London), knew a district not above fifty or sixty miles from London where no one could drink the water from the wells, and every drop of water was collected from the roofs. The problem of getting the water from the roofs and clearing it of defilement, was a serious one, and the people in this case had to use filters and strainers, and so forth, to get rid of the grosser impurities.

Mr. L. L. Macassey, B.L. (Belfast), referred to the case of a friend of his own in Ireland, who wished to provide his country home with a supply of water under pressure. This gentleman obtained the following particulars of a windmill in actual operation at a railway station, and the details might be interesting to the meeting. The mill worked a set of pumps with a lift of thirty-five feet, and raised on an average some five thousand gallons per day; the cost of erection was about fifty pounds, and the superintendent of the railway stated that he found at the end of the first year's working the saving in coal formerly used in the pumping by steam was about equal to the cost of the mill. The pattern adopted was the American self-reefing mill, with a diameter of thirteen feet. The amount of storage required to keep up the daily supply during calm weather was about fourteen days—but it must be borne in mind that the situation was very favourable for catching the wind. Village authorities, as a rule, objected to engines or windmills, or in fact anything likely to get out of order; what they wanted was a means of supply that would work automatically, and consequently a gravitation system was always to be preferred when it could be obtained at a moderate outlay. He was of opinion that fresh legislation was necessary in the matter of acquiring water by means of a provisional order: at present a local authority could not obtain powers to take waters compulsorily in this way; they could take land and sink wells, but if they desired to acquire stream or surface water they had to obtain an Act of Parliament. In the present state of the law, local authorities who could not afford to go to Parliament had to treat with the riparian owners—and anyone who had ever done this would know what it meant—or else they had to resort to a supply of water from wells. One great objection to well supplies was the liability of pollution. The surface soil became saturated with organic matter, and in many cases portions of this matter were washed down into the well through the pores of the ground in wet weather. A friend of his living in the country had a well some distance from his house, which he prized very highly; mineral oil was used in the house, and the barrel of oil was kept in an out-house some little way from the well; by accident the oil tap was left open, and the oil ran out and soaked into the ground; as a consequence, the well-water became undrinkable, and it remained tainted by the oil for over twelve months. This well was thus dependant for the purity of its water on the condition of the surface; and without doubt, many wells in connection with dwelling houses were in an equally unsatisfactory condition.

Mr. J. Corbett (Manchester) remarked that special consideration was required as to the cheapest means of raising water for village supply. After all, the cheapest and simplest power was that of the housewife's arm and the hand-pump, and if they could apply that power to an improved source of supply they would best meet the village wants, and meet them with the least expenditure. He wished particularly to call attention to a case with which he himself had had to deal. The landowner who was making the improvement stipulated that the work should cost so little that he had to come down to the very simplest of means. A good supply was brought into the village by gravitation, but at such a level as to supply only a few houses. All the houses were situated within about twenty feet of the level of that supply. He therefore carried suction-mains to the eight or ten existing pumps, and then supplied new pumps in the old casings. This, with a small covered reservoir, completed his arrangement. In one case he had a pipe 220 yards long, with a lift of 22 feet. He made that pipe only $1\frac{1}{4}$ inch diameter, and it was of lead-encased block-tin. It gave a satisfactory supply, thanks to the expedient of placing an air-vessel with the suction-pipe from the supply introduced into the top of it, and the air-vessel placed at the height of the pump-barrel and connected to its suction-valve at the base. This appliance formed a self-priming cistern for the pump valves and bucket, and also formed an equalising or air-vessel for the long suction-pipe; and the practical result was perfectly satisfactory.

Mr. R. Railston-Brown (Bridlington Quay) said that he had been superintending the waterworks for Market Weighton. They found the place supplied from dumb-wells about ten feet deep, and the drainage in a most unsatisfactory condition. When they went there they found no fewer than eighty cases of typhoid, but within three months of starting their first supply from the chalk, from a well and bore seventy-six feet deep, there was not a case of typhoid in the village.

Mr. A. E. Eccles (Chorley) wished to know how it was that whilst the cities and towns were getting rid of *pump* water, they were now recommending it to villages. Pump water was generally hard water, and hard water was injurious, as it contained lime and other mineral matter, which produced stone and other internal accumulations in the body of man. Wherever it was possible, villages should be supplied with soft pure water from a hilly district, like some of our best waterworks are.

Mr. J. J. Bradshaw (Bolton) observed that they frequently found people in villages had good teeth, whilst those in towns had bad ones. There was that objection to town water, that it had often not sufficient lime in it to aid in the formation of bone. The difficulty of separating pure and impure roof-water was in many cases met by Mr. Roberts' Separator.

On "The Fouling of Streams," by Major LAMOROCK FLOWER, Sanitary Engineer to the Lee Conservancy Board, &c.

WATER!—of Heaven first-born: ever in all ages a sacred emblem, from that remote period when "the earth was without form and void, and darkness was upon the face of the deep, and the Spirit of God moved upon the face of the waters." Alas! in these latter days more abused than is any other element; and fouled streams—from the babbling brook to the broad, once silver highway of nations, and those portions of the "wide, the open sea" (a "stream" within the meaning of the Act of 1876)—amply justify the assertion.

It will be convenient in considering the subject to regard it from three distinct points of view:

1st. The Causes of the Fouling of Streams.

2nd. The Effects thereof.

3rd. Remedial Measures.

I trust my long experience and daily familiarity with the subject may be my excuse, if I appear somewhat didactic in this paper.

First, then—The Causes.

Prominent is inefficient legislation: the permissive character of existing Acts of Parliament which have been framed with the object of abating and preventing river pollution, and the many loopholes which are found in special clauses. Our laws hereon are complicated; they are conflicting, and also are ineffective. Prosecution of offenders is enormously expensive, and the machinery is cumbersome.

The removal of sewage by water-carriage, born of the introduction of the water-closet—which contrivance, some say, was the invention of the devil—lies at the root of much fouling of streams. Sewers are laid by which sewage of towns and villages is discharged direct into streams; or, if into cesspools, these receptacles have overflows which contribute sewage in its worst condition—putrefaction. The fluid part of sewage is the worst part of it.

Then the storm-water outlets, the "back door" to systems of sewerage; there must of necessity be a safety valve of the kind, but this contrivance has too often acted as a "back door," or means of surreptitiously passing large volumes of foul matter

to our streams. For example, given a town of say 10,000 inhabitants which disposes of its water-carried sewage on land, we will say—the land either worked by a sanitary authority, or, it may be, leased to a sewage farmer—what are the conditions? The authority or its tenant is bound to receive and also to dispose of the whole of the sewage of the inhabitants every day of the week, all the year round, rain or shine, heat or cold, presumably on a given area of land; what happens? When all is fair sailing the sewage is properly got rid of, but when storms come or when a hard frost is present, where does the sewage go to? Naturally into the streams again. I am prepared to hear it advanced that sewaged land is not liable to be frozen, and therefore no overflow could take place; but experience teaches me that sewaged land does get frozen, and that sewage does escape over such frozen land into the water-courses. Again, in heavy storms the sewers get overcharged, and volumes of sewage pass to the rivers of our country by the "back door."

Or, the sewage may be disposed of by chemical treatment. What a temptation lies here to save chemicals and let the sewage improperly dealt with pass away. The sewage doctor as well as the chemist, to say nothing of the ratepayers, seem to profit by practically breaking the law. The sewage farmer lets what he does not want of the sewage pass away by the storm outlet. The Local Sanitary Authority saves by starving the chemicals.

Again, unless the sewage be borne to the outfall by gravitation, how excellently good it is to be able to save some few pounds in a year by reducing the pumping expenses; what a feather in the cap of the official in charge to be able to say, "we have saved something," however trivial. "Keep the rates down" has been one of the fruitful causes of fouling of streams—a "penny wise and pound foolish" policy. When will folk learn the value of the wise man's saying, "There is that scattereth and yet increaseth?" and I am sure that many of my hearers can point to the result of following out the principle in their own experience. False economy is another of the causes of fouling of streams.

High farming—the top dressing of lands with manure of all kinds, artificial or otherwise—and the drainage therefrom into water-courses; sewage sludge spread on lands and allowed to drain into a stream also.

Carriage of manure in old and rotten barges is another cause; one of the greatest difficulties I have to overcome in the river Lee is pollution from manure barges. The carriage of manure is specially sanctioned by a clause in the Act of 1868.

Canal boats and house boats on rivers are fruitful causes of pollution; all the refuse from a canal population passes or is cast into the water; and as to house boats, I give a picture from a local newspaper of the condition of affairs at Henley-on-Thames:—"There was a great number of decomposing salad leaves, some rotten fruit, innumerable egg-shells, with part of the yellow of the egg still adhering, several large pieces of bread, the skin of a salmon, a skirt of lamb, stale pieces of fat and meat, some spring onions, innumerable crushed lemons, faded flowers, lobster shells, bruised tomatoes, and a dead roach." The report follows grotesquely, "a bucketful of water taken from the midst of this garbage smelt very unpleasant!"

Inefficient or improper chemical treatment of sewage is another cause. "All is not gold that glitters," we know, and "bright effluents," "pellucid jets of spring water," are often delusive. I always say that the value or otherwise of a chemical process is shown by the effect upon a stream of the effluent which is discharged therefrom.

Privies erected over water-courses are another cause, and similar necessary conveniences placed over ditches also; here the filth accumulates and decomposes, and is washed away into the nearest water-course by heavy storms.

Pollution from manufactory refuse also contributes to the long list of causes of river pollution. How frequently do we read some such notes as the following:—"The river Aire flowing through Leeds contains probably every loathsome and disgusting impurity which exists; it is the open sewer for half a hundred towns and villages; it is the ever ready receptacle for every waste product of mills, tanneries, dye works, chemical works, slaughter-houses, and everything else of which man is in a hurry to rid himself; such a burden does the black bosom of the river Aire bear at Leeds bridge."

Again, we read of the Irwell: "From time immemorial it has been the receptacle for quarry rubbish, surplus excavation, ashes, and refuse of the various manufactories on its banks; and at the present time (1887) the sewage from a population of upwards of a million persons passes, with scarcely an attempt at purification, into its stream." Of the Irwell it is said: "It is the most foully used stream in the world. The staple trade of England is largely indebted to this river for its prosperity, and like many another faithful servant, its well-being has been ignored by those who have derived most advantage from its services."

Refuse cast or allowed to be discharged, of which malting refuse brings about some of the greatest nuisances possible, also fouls streams to a great extent. On the river Avon, one writer

relates that his attention was drawn to a flotilla of floating palliasses or square mattresses, which having been infected, were thrown into the river.

Pail washings, a most disgustingly filthy pollution, to the extent of 30,000 gallons daily, is discharged into a river by the Corporation of an important town situate not 100 miles from this place. Butchers' offal, dead animals, and filth of all kinds are daily heedlessly thrown into our streams as the readiest way of getting quit of them. Sheep washing, again, is a bad pollution.

Some people claim, as an excuse for pollution, "vested interests." Here is an extract from a recent report on pollution from dye and bleach works: "This pollution is of a character which the Local Board finds difficult to cope with, as any interference would inflict such serious injury on these industries that it has always been considered unwise for the Board to interfere beyond making suggestions." This is a specimen of that "masterly inactivity" of which some of us have recently heard.

River pollution is a thing of the last half century following the vast expansion of manufactures and dwellers on the banks of streams. Doubtless it is a very cheap and ready way of disposing of refuse, to let it be thrown into or passed to streams—"the natural drainage of the country," to quote an oft-given excuse; and now the chief polluters complain that to compel them to cease from pollution would be to close their works.

It cannot be admitted that anyone has *a right* to turn out noxious filth, with the result that the health, food, profit, and pleasure of all below the polluter on the river are destroyed.

This brings me to the second part of our subject—the effects of fouling of streams.

I extract the following from a poetical description of a river given some years since by an anonymous author in a sporting paper:—

"Behold the babe! springing from the bowels of Mother Earth. See, it lies asleep in its moss-girt cradle-bed, pure as ever was infant. Soon it crawls over the side of its cradle—its moorland nest—a tiny, strengthless thing. The age of progress once begun, there is no turning back, and soon it has grown into the mountain brooklet—the jolly, noisy, splashing, dashing, leaping, tumbling, boisterous 'burn.' Anon, as if wearied out, sleeping quietly, self-intoxicated, in its own sweet gurgling eddies. Then growing and flowing, till the brooklet of yesterday is the river of to-day. Westward looms a growing haze, and towards that the river slowly but surely is going, 'like as the waves make to the pebbled shore.' Swiftly now, as if con-

fronting a foe, it rolls along, facing the future, dark though it be; proudly and defiantly. It has entered the city! where now the bright sun, the verdant pastures, the song of birds? overhead all is gloom, around, an atmosphere of impurity. Oh! how it chafes, how it chokes! Nobly battling for the mastery, it goes on: a sharp struggle, perhaps, and then out beyond the city. Purity once more—the glorious country and the golden sunshine! Alas! step by step, it grows foul and turbid, and the odours are those of death and decay, not life and health. The river is no longer beautiful and pure, but foul and loathsome. It has emerged from the city, '*bearing its stain*.' How sadly, how painfully it flows now; aye, and flows on till it is lost in the loving arms of the ocean's resistless tide. How like, indeed, to man's life—from the cradle to the grave."

What, then, are the effects of the fouling of streams?

In natural sequence let us look at the laws. To foul a stream is to transgress the law. One effect thereof is to try to escape punishment, and in such endeavour to avoid the consequence of evil, experts have amassed fortunes. It has been said, not inaptly, that it is possible to drive a coach and four through most clauses in Acts of Parliament. I think experience has taught us that in river pollution, at all events, there is some excuse for the legend.

Fouling of drinking water is an effect. Time was when the Fleet Ditch, sewer as it is now, was as "the river of wells," a pure infant, and the water supply of much of London. Soon by filth, contributed by dwellers on its banks and by factories, was it reduced to the condition described by Pope, as

> "The king of dykes, than whom no sluice of mud
> With deeper sable blots the silver flood."

"The silver flood"—The Thames: once the silver highway of nations!

Destruction of recreation is an effect of fouling of streams.

The discharge of impure fluid into the Lee below Tottenham Lock in 1885 practically destroyed the boating trade, and so deprived the hard-working toilers of a large district of London of that amusement which tended to keep up their health, their strength, and their places in the national power; for we must not forget that the strength of a nation lies in the health of its people. Fouling of streams is in effect a national evil.

The special clauses to which I have before referred have the effect of legalising pollution. I will quote a few words from Mr. Ruskin last year, on the neglect of our streams by Parliament:—

"I have not myself noticed much that it has done to any

purpose, except virtually abolishing the Act against pollution of rivers; which repentance of theirs virtually signifies that the management of the millenium we have presently to look to is to be put in the hands of the sort of British patriot who is ready to poison the air and the wells for his neighbours 100 miles round, and to sit himself all his life up to his throat in a jakes, so only that he may lick up lucre from the bottom of it."

An article in an evening paper in August of last year states that—

"Local self-government acts in the opposite direction as to abatement of river pollution.

"The high type of it exists at Hertford, which, for example, insists on pouring its 'treated' sewage into the Lee. When the much maligned Conservators try to prevent Hertford from doing this, they are fought in the law courts from point to point with bitter and dogged tenacity. Nor can we blame Hertford; just as Bath and its satellites convert the once pellucid Avon into a turbid torrent of filth:

"The law allows it, and therefore courts have awarded it. If anyone is to be blamed it is not the municipalities but the legislature, whose clumsily drafted enactments give municipalities in such circumstances a legal right to poison pure sweet streams with sewage."

Pollution of a river spoils the pleasure of every one dwelling on its banks. The landscape is ruined; a peaceful contemplation of the country is impossible with the odour of ten thousand sewers in the air: the angler is banished: during the last twenty years the trout streams have been depopulated to the extent of from fifty to one hundred per cent.; and the refining influence of a pellucid stream hurrying onward to the great ocean, fit type of the larger stream of life, is lost in the accumulated filth of cities, towns, and parishes.

The lower manufacturers on the banks of a polluted stream are sufferers by the pollution of those above them.

To them the effects of fouling of streams are injury to health, to enjoyment, and to trade.

We come now in the third place to remedial measures.

New legislation is absolutely requisite. The Act of 1876, brought about by the noble Lord who presides over our Congress, was a step in the right direction, but I am sure his Lordship will admit, and, in fact, did admit in his opening address, that very much more is wanted before we may flatter ourselves that any effectual legalised means exist to prevent river pollution.

"Thou shalt not," must be the motto of any future laws on

the subject. A shorter course of procedure in punishing offenders must be brought about. No roundabout way of getting one's ends accomplished, but action, short, sharp, and decisive.

The late Attorney-General, Sir Charles Russell, considered that the failure of the Pollution of Rivers Act of 1876 to do all that was expected of it was, "because the local sanitary authorities, who were generally the chief offenders, were entrusted with the power of enforcing the Act."

In 1885 we read that the German High Court recently gave notice to the municipal authorities of Essen-on-the-Ruhr, that if the town sewage, at that time flowing into the river, was not conveyed elsewhere or pumped in a systematic and satisfactory manner on or before a certain date, not only would a penalty of 1,000 marks a day be inflicted, but should any nuisance dangerous to health be found to exist, the magistrates of the town would be sent to prison.

The effect has already been magical at Essen-on-the-Ruhr, and probably if we could give half the members of the Metropolitan Board six months "hard," an improvement would be found in the neighbourhood of Barking and Erith.

Recently also in Russia a factory polluted a river. The Czar ordered that within a certain specified term, the pollution should be abated on pain of pulling down the factory, and a military force was marched on to the neighbourhood with instructions to carry that order into effect. The result was, proper measures were taken, the nuisance abated, and the factory works on.

We are too permissive in our legislation. Again I say, "Thou shalt not" should be our watchword. Fresh legislation then is one remedial measure.

This matter should be taken up by the government, and an effective public measure introduced to the consideration of both Houses of Parliament.

Perhaps we may find that sanitary matters and prevention of fouling of streams may form an important section in the promised "County Boards" Bill.

In laying-out systems of sewerage, no storm outlet should be permitted which does not discharge on to an area of land or on to an adequate filter; and where neither of these can be obtained, then the sewage overflow should be disinfected.

Storm overflows are sometimes sanctioned by Parliament. One case in point is that of the main drainage of London, which pollutes the river Lee at Old Ford; to lessen the evil of this I suggested certain automatic machinery for the application of efficient chemicals, an idea which found favour with the

Metropolitan Board, and is under their serious consideration with a view to my ideas being adopted.

There are very few places where the remedial measures which I suggest cannot be carried out.

Thus I propose the evils of the "back door" shall be abated.

Then as to disposal of sewage. I am not going to travel over the old well-trodden track and thrash out the sewage question *de novo*.

There are now certain well-known and adopted principles. First of all comes the land. Shakespeare says: "The earth's a thief that feeds and breeds by a composture stolen from general excrement." It is pretty generally admitted that in disposing of our refuse it should be "earth to earth," and the disposal of sewage on land must rank first in all our modes of disposal; but where sewage lands are, care must be taken against the contingencies which I have noted in speaking of the causes of fouling of streams. There must always be an area laid out to receive possible excess of sewage or of storm overflow; and a belt of osiers properly planted is a good remedial measure.

I shall not attempt to follow the myriads of chemical processes which have from time to time been brought into public notice, and shall merely record certain results which have come prominently under my notice.

Where land cannot be obtained in sufficient quantity and of an appropriate character, deposition of the solids of sewage may be effected by chemicals. A much less area of land is required for merely depriving the effluent of those organic matters which no chemical process has yet been able to remove. I speak within reason.

I believe I was the first man who tried, on a large scale, the combined method of chemical and land treatment. This was done at Enfield, and the result was satisfactory in every sense; in fact it is now fully admitted that dealing chemically with sewage, and following this by filtration through land, is the highest form of sewage disposal.

Of course where deposition of the solids precedes irrigation or land filtration, there is the question of sludge to be dealt with. Dehydration by pressing is a valuable auxiliary in disposing of sludge; and if this be followed by the furnace, we get a result which is undeniably of value.

As to burning of sewage sludge, I have for some time carefully watched certain experiments made with a view to see how far coking of coal and incineration of sludge-cake might be combined. This has been effected with great success: the mode by which it has been achieved forms one of our exhibits.

As to carriage of manure, it is surely possible to prevent nuisance by seeing that only sound craft are used for the purpose.

Respecting house-boats and the nuisance therefrom, closets thereon should be abolished, and a scavenger-boat be established, which should each morning remove the refuse, garbage, ashes, &c., &c., from the boats.

As to efficient chemical treatment, it must never be admitted that any one system is equally applicable to all places, nor must mere clarification be mistaken for purification. I can point to cases where fluid, as clean apparently as spring-water, is discharged from the outfall works, which before going a mile becomes putrid; and to other places where an effluent, not good-looking in appearance, is discharged, but which being passed into a foul river actually improves its condition.

Then refuse from manufactories. This might be met by making the manufacturers deal with their own refuse on their own premises, and not pour the said refuse into the public sewers to increase the difficulties at the outfalls, nor into the rivers to foul them direct.

The recovery of waste products may in most cases be remuneratively carried out; and in one case, the refuse of soda manufacture is specially treated by Messrs. John Hanson & Co., of Wakefield, and used for sewage treatment with very great success. This must not be confounded with employing fresh black ash waste in treating sewage.

Although much has been effected in abating river pollution, a very great amount remains to be done; and I submit that, as I said ten years ago, if we want to have our streams free from pollution, we must map out the country in watershed areas, and put each under the charge of an experienced man, backed by a good Board, who should legalise his acts.

In conclusion, I think we must admit that the remedy against a condition of affairs, which is to us a national disgrace, is—mainly, improved legislation; abolish all special clauses or exemptions; and make the fouling of streams a penal offence. We shall then probably cease to hear complaints like the following:—

"The rapacity of property owners, the greed of manufacturers, the 'masterly inactivity' of local authorities, have secured for us the pestilence-laden atmosphere which robs us of our nearest and dearest, and the heavy taxation which wears out the heart and energy of the suffering ratepayer." And may use the words of a writer in *Engineering*, on the struggles of a progressive Board whose motto, like that of Bolton, was "onward, ever onward," which, on the completion of its labours, could

with a clear sanitary conscience say, "we have gained for our district that title to civilization which must be denied to any community, however pretentious, which consents either from ignorance or false economy to welter in its own emanations. Health we have given which is wealth, and more than wealth, and cleanliness which is next to godliness"—a condition to which all may attain.

Mr. H. Law, M.Inst.C.E. (London), said that when the law required that cesspools should be abolished, the sewage from water closets was transferred to and polluted our rivers. The question of river pollution was a large one and did not arise entirely out of the pollution from sewage. Probably there would have been little difficulty in obtaining wise and sufficient legislation on the subject of the prevention of river pollution if it had only been a question of dealing with sewage. But when it came to a question of interfering with manufacturing interests no Government had felt it wise to deal with the subject. He himself took part in the deputation which waited upon the present President of the Local Government Board not very long since for the purpose of urging upon him the importance of legislating upon this subject. He (the President of the Local Government Board) explained to them that in the present depressed state of trade it was no use recommending to the Government that any measures should be proposed which would in any way restrict the present license, if he might use the term, which was accorded to manufacturers. He himself thought that if a commission or some other machinery were appointed which could fully enquire into the subject, it would be found that a great deal of manufacturing pollution which now exists could be avoided, greatly to the advantage of the manufacturers themselves. That, he was sure, could and would be done; but in the present state of want of knowledge as to how pollution could be avoided without restriction of trade processes, he was afraid they must not look for any drastic measure of legislation. As to the sewage, there could be no doubt that its application to the land was the natural way of treating it and, where it could be adopted, the best. He and his brother engineers who had had experience in the various schemes proposed for dealing with the sewage of towns and villages, must have experienced the immense difficulties created by the opposition of land-owners and residents to allowing land to be taken for the purpose of a sewage farm. That was the great difficulty in the way of the system. His opinion was that the best plan was first to apply a proper chemical process, and then follow that up by passing the effluent through the land; but he was also of opinion that the difficulty had been immensely reduced by the introduction of the sludge-pressing system.

Mr. J. J. Bradshaw (Bolton) pointed out a cause of fouling which could not be considered as sewage. In the neighbourhood of Bolton there were very large works situated on the banks of the Irwell and other streams, where the owners regularly disposed of their cinder heap by pitching it into the river every time there was a flood. Sometimes there were as many as twelve men hard at work throwing into the river this refuse and letting the flood carry it away.

Dr. Alfred Carpenter (Croydon) said there could be no doubt it was a wrong thing to send our sewage down to our neighbours; there was a time when we used to send our moral sewage to distant countries, but those distant countries objected, and now we treated it at home with greater success and more judiciously, and he contended that we ought to deal with our own sewage in our own localities. Bolton must deal with its sewage in such a way that it will not become a nuisance to their neighbours, as would be the case if it were emptied into the stream to be carried down possibly to destroy the health of others below them as regards elevation. It was possible to prevent that fouling by taking out that which caused the mischief and utilizing it in a way that it should be an advantage to the people who had produced it; just as it was possible to take the smoke from the atmosphere he saw before him and utilize it, so they could do in regard to sewage. If it were possible to apply the sewage of large towns to the land and to apply it at once, and to his mind there could be no doubt about it, there could be no mistake about the propriety of that course being taken; though there were certain erroneous ideas in the minds of the people which prevented that course from generally being taken. People thought that sewage necessarily stank. Fresh sewage did not stink, and if fresh sewage were applied at once to the land there was no likelihood, or ought to be no likelihood of smell at all. To produce smell in sewage, time was required, because it was the action of living organisms that led to the decomposition of the material. Until those microphites had been at work there was no room for smell, and if sewage were got on the land within a certain time after its production there was an absence of smell. They might use their sewage close to the population which produced it, provided it were properly and scientifically managed, and they might use it in a manner which would be utterly free from objection to the neighbouring inhabitants; the moment they got sewage on land the change which took place was in a direction antagonistic to the production of smell. The action of earth or vegetation produced such a change in arresting actions so that micro-organisms could not be produced, and there was of course an end to all smell; and this fact was illustrated when the cat misbehaved itself in the hall and the servant sprinkled the result of its misbehaviour with earth. Sewage which came fresh from the body was not harmful, or else everybody would be poisoned by their own excreta; those were simply ethereal smells which were dissipated at once and did not rise to mischief; those which did mischief were associated with a certain fermentative process taking place in

changing organic matter which was ceasing to live, and if they stopped that, which the earth or vegetation would do, they had at once a removal of the conditions which gave rise to smells which were injurious to health. He had had under his eyes for the last three-and-thirty years an illustration of the effective manner in which the work could be done. He was speaking as to its scientific aspect, because sewage farming was a purely scientific process, and if it were managed by unscientific people, by unscientific committees of Local Boards, they might depend upon it it would be a scientific as well as a financial failure. If, however, a sewage farm were conducted properly, there would be a sufficient return from the proceeds of that farm to pay all the expenses of management, to pay a certain percentage upon the outlay as far as the farming arrangements were concerned; but there would be nothing to pay interest upon the sum that was required for the purpose of acquiring a site for the farm—that was a burden which must be borne by the locality. The locality provided the sewage, and the locality must provide the means of taking that sewage out of the water; if they left that as a charge upon the locality, they need not pay one single sixpence in annual cost for farming purposes. There were difficulties in obtaining land in a locality like Bolton, but it was not necessary that the land should be in close proximity; they might have areas here and areas there, and if they could command those areas by gravitation they might be actually in the grounds of a gentleman's park, and there was no difficulty in so arranging their sewage that there should be no mischief and no miasm from it that would be injurious. There was no reason why they should have any kind of effluent which could not be admitted to any fresh waters. There were of course difficulties in the way of managing this, the principal of which was the want of scientific knowledge. It was certainly easier to adopt a precipitating process of mixing lime in the water and getting rid of the suspended matter and letting the effluent go, but by that means all its manurial qualities were lost to the country; he thought it was an injury to the country that this should go on. We were now-a-days so considerate of £ s. d. that if it were seen there was a possibility of expense upon the locality, they did not so much look at that side, and at once took up the sentimental aspects; that was the side he was always fighting against, and it always expressed itself in this: that to bring a sewage farm close to a population, was to introduce the elements of disease. There was no reason whatever why it should be anything of the kind; though sentiment has often more to do with the failure to establish a sewage farm than anything else, the very high price which would have to be paid for land for the purpose close to a town was often a serious drawback. Where it was impossible to carry out the course he suggested, then there were ways by which precipitation methods might remove the suspended matter which developed mischief, and also take out some of the albuminoids which were likely to produce disease. The locality which allowed one of the ordinary streams of the district to be fouled by their sewage, whether that sewage contained only, as was the case at Bolton, dissolved material that

came off and was not visible, or whether it was that visible material which was taken out here, and did go in in some places; they were failing in their duty, and were not doing what they ought to do, both as local legislators and as citizens of a county which ought to grow food enough for its people to live upon, without having to depend upon the foreigners for our food supply. Utilization of our sewage by farming would help us to do this.

Mr. Rogers Field, M.Inst.C.E. (London), could not agree with Dr. Carpenter that it was a right thing to take the sewage from towns and discharge it on gentlemen's estates. But putting this point aside he thoroughly agreed with the doctor with regard to the difference between fresh sewage and sewage that was highly putrefied. It was a distinction that was very seldom recognised, but it was one of vital importance. In order to dispose of sewage without giving offence the sewage must always be fresh, and it was there the difficulty lay, as in the case of towns it was almost impossible to get fresh sewage. In the case of many large institutions, such as lunatic asylums, hospitals, workhouses or large mansions, the conditions were more favourable, as the whole of the drainage system had frequently been carried out "*de novo*," so that it was self-cleansing. There was then no decomposition, and they might deal with the sewage on the land without any trouble or difficulty, or any offence at all. The way the matter was frequently treated, however, was to conduct the sewage into cesspools and then take the overflow of the cesspools on to the land. This method was doomed to failure, inasmuch as the cesspool was a mass of decomposition. The very first thing was to do away with the cesspools; but this was not sufficient; they must also go further than that: do away with all sewers, drains, and traps which favoured deposit, so that the entire system should be self-cleansing. Then and not till then the sewage would be fresh, and the disposal be effected without offence. The question naturally arose, How was this to be done in the case of towns? There were of course great difficulties, but they were getting much nearer to it. He was glad to know that in many towns now very great attention had been paid to the subject, and very stringent regulations had been made with respect to house drains, which were generally the great offenders. All defective house drains should be reconstructed; new sewers should be substituted for the old ones, and everything got into a better state, and just in the measure that this was done would they find themselves able to deal more satisfactorily with the sewage. As matters now stood, in towns it was frequently necessary to have some chemical process, as they were dealing with decomposed sewage; but if the sewage were delivered on to the land in a perfectly fresh condition, a chemical process would not be necessary. It could not be too strongly impressed upon Boards of Guardians, or those responsible for large institutions, that there was no reason whatever in the vast majority of cases why sewage could not be dealt with most satisfactorily on land.

Mr. W. Wilkinson (Bury) ventured to say that the question of £ s. d. had a great deal to do with the tardiness which characterised the dealing with sewage in Lancashire. He rose to bring before the notice of the members a suggestion which was made when their Council was discussing the question at a recent meeting. It was that inasmuch as the landowner is the chief person to benefit by the pollution of rivers with the sewage of towns as his land is increased in value sometimes ten, twenty, or thirty times by the building of houses and the turning of sewage into the rivers, the landowner is liable for a share of the expenses in the purification of that sewage. As far as he knew they had no means at present of getting at the landowners and making them pay their proportion of the expense of purification.

Mr. L. L. Macassey, B.L. (Belfast), asked Major Flower what form of legislation he thought should be adopted to remedy the existing grievance. It was a pretty well settled question now that rivers in many parts of the country were polluted beyond endurance. It was a mere matter of money to make things right, but the question now was "What is to be done?" It would be very important if an Institution like theirs could go the length of giving a formal expression of opinion on the subject. If they could get some idea for the skeleton of an Act of Parliament he thought it would be well. The Rivers Pollution Acts had been rather unworkable, because no one at the time they were passed knew very much about the question of how the remedy was to be applied; and the Legislature, feeling the difficulty, left the matter a very open one. Nearly all legal proceedings against parties polluting streams had been taken at common law and not under the statutes. He thought if an expression of opinion came from a body like this, or if the matter was referred to the Council to deal with, it could in course of time be brought under the notice of the Legislature. The Sanitary Institute included amongst its members many gentlemen who, having given special attention to this subject, were able to speak with authority upon it, and no doubt the opinion of the Institute would receive careful attention.

Major Lamorock Flower (Lee Conservancy) said Mr. Law and he were practically on all fours in their opinions. The President of the Local Government Board was a manufacturer, and looked at the question from a manufacturer's point of view, hence the answer given to the deputation to which Mr. Law had referred. Putting ashes into a river could surely be prevented by common law, but putting a small quantity in had really preserved many a stream in Lancashire from being beastly. With regard to Dr. Carpenter, everybody knew his views on the treatment of sewage. There was but one Dr. Carpenter in the world, and he had always said that if the doctor's theories could be carried out, people would have no reason to complain of stinks and annoyances from sewage farms. He agreed with Mr. Field, that it was necessary to deliver sewage fresh on to farms,

but this was impossible under the present conditions upon which they received sewage from towns. It did not come down to the farms fresh, but stinking, through badly constructed sewers. He happened to know one or two cases where sewage from mansions was disposed of without offence, on gentlemen's parks even, and nuisances which used to go into the drinking water of London, were prevented. He thought it was perfectly possible in the case of large institutions to deal with sewage upon land entirely without offence if the sewers were properly constructed.

Mr. W. Wilkinson (Bury) said it was rather hard lines to fall upon land-owners and ask them to pay for the drainage of a town. They needed some legislation on the subject.

Major Lamorock Flower (London) said one of the speakers wished him to give a special opinion as to the proper lines upon which a new "Rivers Pollution Act" should be framed. He would rather not commit himself to any definite expression of opinion on this occasion. They would consider the matter very fully in Council he believed. Many of them belonged to a society which had done a great amount of good, but which had unfortunately not been much backed up. It was the society to secure effective legislation against river pollution. One of its proposed Bills had been kicked out of the House by the agency of manufacturers, who said they could not afford to keep sewage out of streams. If the law were to say to each manufacturer that he must deal with his own refuse on his own premises the manufacturer would benefit, and the rivers would be in such a condition that perhaps they might even catch salmon within a mile or two of a manufacturing town.

On "House Drainage," by Reginald E. Middleton, M.Inst.C.E., M.Inst.M.E.

Public Sewers.

As the necessity for some of the requirements of house drainage depends on the *sewer*, the writer proposes to say a few words on this subject before dealing with house drainage proper.

So far as the drainage of a house is concerned, it is necessary to deal with sewers as they exist, not with a theoretically perfect condition of things. Sewers, as separate pieces of construction, may be, and frequently are, admirable; but as channels for the rapid removal of all that passes into them they are faulty.

Sewers in most of our towns are designed not only for the removal of excreta and vegetable matter, but they have also to receive a large amount of storm water, necessitating the presence of washings from roofs, street sweepings, &c., and they should therefore be constructed to provide a rate of flow in them which should remove much heavier substances than those contained in sewage proper. If this be not done, the more ponderable matter will subside, and even if this subsidence be regular, there will be a considerably reduced rate of flow due to friction; and as the subsidence never is regular, bars will be formed in the sewer which, unless removed by flushing or excavating, will in time close the sewer altogether, or make it nothing better than a cesspool.

The necessities of practice and the configuration of the ground in almost all cases prevent the possibility of sewers, worked by gravity only, being laid to such gradients as will produce a regular rate of flow sufficiently rapid to remove the ponderable matter, or the sewage proper, in a space of time sufficiently short to prevent deposits and fermentation in the sewer; thus, as fermentation must necessarily take place, and as the householder has no power over the cleansing or ventilation of the sewer, it becomes his duty to separate the occupants of his house from the possible and probable effects of any direct connection with a receptacle or channel which contains gases injurious to health, and may contain the germs of serious disease which have passed into it from some other habitation.

If the drainage of all houses were in such a condition as to get rid of all matter liable to decomposition at once, and it were not the fact that, owing to the faulty construction of many house drains, decomposition has already become active before the matter to be removed has ever reached the sewer, if the sewer were self-cleansing and thoroughly ventilated, and the dangerous matter were removed before fermentation set in, if it were not the channel through which must necessarily be passed excreta carrying with them the germs of disease, *there would be no necessity for the careful* separation of the several systems of house drainage from the sewer proper; but as sewers do receive matter already decomposed, as they do not at once remove matter subject to decomposition, and as they are not thoroughly ventilated, it is necessary that each house should be disconnected as effectually as possible from any chance of contamination from this source, and the intercepting trap between the main house drain and the sewer is a necessity.

Much exception is taken to the system at present in force for the ventilation of sewers, and it is proposed by some to put a large ventilating shaft at the head of every sewer; but a very

small amount of calculation will prove clearly that, even if the openings into the street were closed, any such system would be perfectly ineffectual, and that if the street openings remain as they are, any such ventilation would not extend beyond the first or second of these openings. If sewers could be cut off into short lengths with an effectual seal at either end there would be no difficulty about the matter; such an arrangement is easily ventilated; but how to ventilate a large length and area of pipes open in many places, either into the air or to other sewers, the writer knows not. The ventilation of a coal pit will serve to illustrate the difficulty.

Street openings are frequently offensive to the sense of smell because the sewer is foul, but this is not a reason for closing up the openings into the streets, which would have the effect of forcing the gases into the houses by the pressure of the sewage when increased in volume during the day, or by a sudden access of storm water, or by the expansion of the gases themselves, or by a combination of two or more of these forces; but rather for increasing the number of openings, and thus reducing the temperature in the sewer as compared with the outside atmosphere in cold weather, and diluting the gases to the utmost extent possible. It is of course obvious that if fresh air be admitted foul air must be expelled.

If sewers can be efficiently ventilated there should be no delay in doing it. The proposal which seems to the writer to have the most practical value, is that of carrying a pipe from the sewer to a point above the roof of every house, or of certain houses on one side of the street only, or alternately on one side and the other, but so that ventilating pipes shall not be opposite each other on the two sides of the street. The ventilators should not be connected with the house drain or with that part of it which is in the street, as this is liable to be flooded, and the ventilation would then be stopped, but with the highest point in the sewer. To make such a system of ventilation efficient, it would be necessary that a street opening should be placed midway between each pair of ventilating shafts, or if the shafts did not rise to the same elevation above the sewer, they should be so spaced that each should receive an equal amount of air in proportion to its requirements from the street opening, and the latter should be of ample dimensions so that the in-draught should not be checked. Taking the difference of temperature between the column of air in the ventilating pipe and that of the atmosphere at the street opening at 5°, or supposing that the expansion of the gases produces a head equal to this difference of temperature, then a 4 in. pipe 40 ft. high might be expected to change the air in a 60 ft. length of 3 ft. sewer

running one-third full in 14 minutes (see Hood on "Warming and Ventilating Buildings," p. 364), or in other words, in order to change the air in 27 cubic feet capacity of sewer five times per hour, a ventilating pipe 40 ft. high and having a sectional area of 13 in. will be required on the supposition that a difference of temperature equal to 5°, or a difference of head representing the same amount can be secured. Having made these few remarks on the condition and ventilation of sewers, the writer proposes to proceed to the consideration of house drainage proper.

House Drainage.

It is proposed to take certain propositions as axioms granted by all sanitarians, and to enlarge on these. The axioms are taken from a report prepared by a committee appointed by the Civil and Mechanical Engineers' Society.

If no remark be made on any particular axiom it is considered that none is required.

(1.) Every drain, or part of a drain, inside a house, and all soil-pipes, shall be watertight throughout. The writer believes that this requirement can be thoroughly carried out with glazed stoneware pipes, if they be thoroughly bedded in concrete, and no contact with any part of the foundation of the house be permitted. He, however, prefers to use cast iron pipes where a drain passes through a house, and considers that with this material it is to be preferred that the supports should be at considerable intervals, and that access to all the joints should be simple and easy, and that the drain should be in such a position that it will come under constant inspection. Under these conditions leakage can be quickly detected, and injuries from rusting may be reduced to a minimum.

(2.) The main drain of the house shall be ventilated at its upper extremity by means of a continuation of the soil-pipe, or by a special pipe provided for the purpose, such ventilating pipe, whether connected with the soil-pipe or otherwise, having a clear sectional area of at least 10 square in. throughout, and being carried to such a height that its outlet shall be at least 3 ft. above the eaves of the roof, and the same distance above any window or opening in the roof not being a chimney, and not less than 6 ft. distant from any chimney or opening in the roof, whether of the house to which it belongs, or of the next adjoining house measured in any direction. The main soil-pipe shall be similarly ventilated, and if there be more than one soil-pipe, then each such soil-pipe which shall be longer between the basin of the closet and the main drain than 8 ft. shall be

similarly ventilated. The main drain shall be disconnected from the sewer or cesspit by means of a syphon trap of approved construction, provided with means for cleaning the trap, and the portion of the drain between the trap and the sewer or cesspit, and it shall be ventilated by an inlet air-pipe or ventilated disconnecting man-hole; and if there be more than one outlet ventilating pipe connected with the house drain, then each such portion of drain and outlet ventilating pipe shall be provided with a suitable syphon trap and an inlet air-pipe or disconnecting man-hole, as already described; and the area of the inlet air-pipe shall in all cases be at least double that of the outlet ventilating pipe in the clear.

It is contended by some writers that the inlet for fresh air should be at the head of the drain, and the outlet at or near the disconnecting man-hole. The objection to this arrangement is that the soil-pipe will either remain unventilated or a separate system of ventilation will have to be provided for it, thus introducing unnecessary complications. The argument in its favour, that it follows the flow of the drain, does not seem to be at all conclusive, for as no house drain ever runs more than one-third full, unless under most exceptional circumstances, there is not much reason to fear that the air passing up the drain, which is more volatile than the water flowing down it, would have its current arrested by the traversing current of water; on the contrary, it is probable that the effect would be that the current of air would be temporarily accelerated, and especially would this be the case when, as frequently happens, the drain has a diameter of 6 in., while that of the ventilator is 4 in.; also, if the water in the drain were giving off vapour this would rise in the drain and travel in a direction contrary to that of the water; this, therefore, seems to be the natural direction of the current.

Writers have repeatedly stated that the number of ventilating shafts should, if possible, be increased indefinitely, and from some of the statements to this effect it may be inferred that the relative elevation of the several shafts is a matter of no importance, and that rain-water pipes may be used for this purpose. It cannot be too often or too urgently repeated that this is altogether a mistake (see Hood on "Warming and Ventilation of Buildings," p. 360), that under no circumstances should rain-water pipes be used as drain ventilators; they cannot go above the eaves of the roof, and therefore the foul air from them is liable to enter the house; also if more than one upcast shaft be used it will not, unless each shaft be of exactly the same height and heated to exactly the same extent, and affected by the wind in just the same manner, increase the ventilating

efficiency, but will rather diminish it. The writer has frequently come across systems of ventilation which were faulty on this account; but when the system of ventilation is simple, that is to say where there is one upcast shaft for each inlet, where the inlet opening is of ample dimensions, and leads as directly into the drain as possible, with few or no angles or bends, he has found no difficulty, and he is of opinion that cowls of any kind should be avoided, and that a Mica return flap on the inlet opening is unnecessary. Where the work can afford it, a ventilating disconnecting man-hole should be built, as it affords easy access to the drain; but a perfectly satisfactory arrangement can be made without it so long as the drain remains in good order.

The disconnecting trap should be self-cleansing; therefore, it must be of large radius with easy curves in all directions, and there must be no projections or corners in it which will either arrest the flow through it or tend to collect deposit. These requirements condemn all forms of dip trap, and in fact the only trap which will satisfy them is the ordinary syphon trap, if the radii of the curves be sufficiently great, and it be of good form throughout and well glazed. No inspection pipe in the middle of the length of the trap is possible; this would seriously retard the flow and cause deposit. A cascade action is recommended by some, but consideration will, it is thought, show that this action, while it may by the greater head obtained with a small supply of water force an obstructed trap, does not really offer any advantage which does not exist to a greater degree in the ordinary syphon described above. If with the cascade action a greater local head be obtained with a reduced amount of water, it is at the sacrifice of the general gradient of the drain, and therefore of the rate of flow in it. With the cascade action the distance travelled is greater than with the other system for the same fall, and the very fact of the head being obtained proves conclusively that this trap has a retarding effect on the flow, and the conclusion arrived at by the writer is that it is far better to make the best of the gradient procurable, to have a length of drain next to the trap from 1 ft. 6 in. to 2 ft. long, falling at the rate of 1 in 6, than to have a local vertical fall, whether small or great, and that in this manner a far better scouring action and a cleaner trap would be secured than with a cascade action trap.

(3.) No pipe which passes through any part of a house not being a soil-pipe or soil-drain shall be connected directly with the main drain.

(4.) No water-closet shall be situated next to a larder or place where food is stored. No pan-closet or D trap shall be

used, and every water-closet shall be trapped, and shall be arranged so as to prevent syphonage.

(5.) The overflows from safes of closets and of baths, and from cisterns, shall be discharged into the open air in an exposed position, and shall not be connected with the soil-drain or rain-water pipes, either directly or indirectly, but shall act as detectors.

(6.) All sinks, baths, lavatories, and urinals shall be trapped with suitable traps, and the discharges from them shall be carried outside the walls of the house, and shall not be connected directly with any soil-drain, nor shall they be introduced under the grating of any trap, but they shall terminate in the open air, and not near any window or other opening.

The writer is aware that many sanitarians prefer to introduce the pipes leading from sinks, &c., under the gratings of the yard gullies, but he thinks that this is a mistake, and that it is far preferable that the discharge should be made fully in the open air, so that there may be as little chance as possible of the collection of any matter in the pipes, than that it should be hidden out of sight and, possibly, choked. If the gratings become foul from this cause, it is better that this should be apparent than that it should be hidden; it is the object of scientific drainage to bring any collections of foul matter to light, not to hide them.

(7.) All water-closets, urinals, and slop sinks shall be provided with suitable flushing cisterns, and the flushing-pipe for any closet shall not have a less internal diameter than $1\frac{1}{4}$ in., and the height of the flushing cistern above any closet, urinal, or slop sink, shall not be less than 4 ft. It shall be impossible to draw water from any cistern used for flushing purposes for any other purpose than that of flushing.

(8.) The cisterns used for general purposes shall be easily accessible, and shall be provided with covers ventilated into the open air outside the house by a rising pipe other than the overflow pipe, and no pipe from them shall be connected in any way with any soil-pipe drain, or with any pipe receiving the discharge from any bath, lavatory, urinal, sink, or flushing cistern.

(9.) No rain-water pipe used to receive the waste from any bath, lavatory, sink, or urinal, shall be placed near a window or other opening, and no rain-water drain shall connect directly with a soil-drain, and no rain-water pipe shall be used as, or connected with, the soil-pipe nor as a ventilating pipe.

Though there are many bad sanitary appliances in the market, the selection of good ones is a simple matter, requiring little more than common sense knowledge, it being obvious that sharp bends and angles and straight vertical sides are undesirable,

that all utensils should retain matter liable to decomposition for as short a time as possible, but should pass it quickly to the drain, which in its turn should pass it quickly to the sewer. Complications both in apparatus and in the drains and ventilating and inspection chambers are most undesirable, and economy without loss of efficiency should be studied. Finally, whatever sanitary work is done it is of the first importance that it should be done well, that the construction should be thoroughly accurate and carried out in a trustworthy manner.

[*For discussion on this paper see page* 286.]

On "The size of House Drains, and the use and misuse of Traps," by JOHN HONEYMAN, F.R.I.B.A.

RECENT investigations seem to prove that certain elements of ordinary atmospheric air—chiefly oxygen—acting upon aerobian microbes, destroy or attenuate their virulence, so that in either case the microbe, as a vehicle of specific disease, is annihilated.* The significance of this fact, in relation to the proper ventilation of sewers and house drains, has, I think, not been generally realized. The earlier advocates of such ventilation—among whom I venture to claim a place—aimed rather at the dilution and rapid removal of sewage emanations than at the destruction of associated microscopic organisms; but they were not without some apprehension of the truth, since demonstrated, that such organisms are practically destroyed by the action of atmospheric oxygen. It is exactly thirty years since I myself published a paper on sewer ventilation, in which I endeavoured to arouse the better class of my fellow citizens by pointing out the fact that while they in the most elevated and least crowded parts of the city had to submit to the frequent recurrence of epidemic disease, the people on the banks of the river (which seemed to them so pestiferous) were almost exempt from anything of the kind. And my explanation was this: I said that "the agents at work in both localities were identical, but they were *differently developed.*" In the one case tainted air, undiluted and confined for miles in unventilated sewers, remained pestilential, whereas in the other, "mingling freely with the

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* I venture parenthetically to ask, if the protective effect of attenuated virus can only be obtained by inoculation? There seem to be grounds for inferring that it may also be obtained by inspiration or absorption.

atmosphere, it became harmless—as a homœopathic globule in a glass of water." I would be inclined to use very much the same language now—and I regret to say there is almost as much need to use it—but we have made an immense stride when we are able to plant our feet upon ascertained fact instead of reasonable but somewhat vague deduction.

We may indeed say that we have now a new and potent argument in favour of drain ventilation. We advise it not merely for the dilution of noxious gases, and their rapid removal, or for the relief of hydrostatic pressure, or the aeration of sewage, but also for the destruction of disease germs, or at least the attenuation of suspended virus; and it is evident that if we succeed in this we render our aerial drainage, if I may so call it, innocuous, so that even if it accidentally gained admission to our houses it would do no harm. To secure this, however, even partially, it is obvious that we must allow a much larger volume of fresh air to pass through our drains than has hitherto been customary—in short the more nearly we can make them approach in airiness to the condition of open drains the better. These remarks apply to drains of every size, but in this short paper I shall refer to house drains only.

One reason why I do so is that it seems almost a hopeless task to convince those who have control of the common sewers that anything in the shape of ventilation is called for. After nearly forty years of sanitarian effort, argument, entreaty, and painful and costly experiences, it is now almost as necessary as ever that those who connect their drains with common sewers should carefully protect themselves against the risks they run in doing so. In this and many other things, sanitarians have been very much like the "importunate widow," but after so many years' ineffectual reiteration of the same tale, they may almost be pardoned if they begin to despond. In the case of house drains, however, they are able to appeal to individuals, and individuals are more amenable to reason. Now, our house drains are under our own control, we can cut them off entirely from the common sewer and ventilate them as much as we like; and in view of the facts already referred to, this important question presents itself: do we in practice ventilate our house drains sufficiently to secure the best results? I think it is perfectly manifest that we do not, and that it is simply impossible to do so with drains of the size generally used.

Pipes of small diameter are recommended to facilitate rapid flow and scour; but we want rapid flow and scour of aerial as well as of liquid sewage, and we are met by this difficulty, that whereas small pipes are best for the one purpose, large pipes are absolutely necessary for the other. Now while we admit

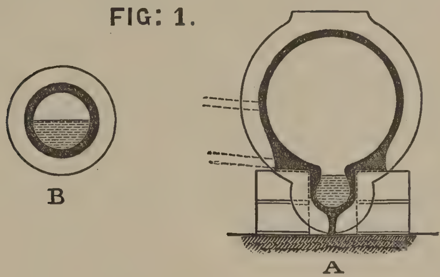
the importance of dealing with the aerial as well as the liquid contents of drains, we have hitherto made no adequate provision for doing so. We have, no doubt, several schemes of drain ventilation which are theoretically good, and which are useful so far as they go; but they stop a very long way short of that thorough flushing of the drains with fresh air which is desirable. In order to bring out clearly the difference between what is usually done and what I think ought to be done, let us suppose that we are dealing with a house of moderate size, having, say, two baths, three water-closets, three basins, and three sinks; a 4 in. pipe would suffice to carry away the sewage from such a house, but in practice a 6 in. pipe would probably be used. Now in many—I fear I must still say in most—cases no attempt would be made to ventilate this drain at all, although soil-pipes connected with it would for the most part be ventilated. In some an outlet shaft would be provided, 2 in. in diameter, in some 3 in., and in a comparatively small number shafts 4 or 4½ in. in diameter. Let us consider the state of matters in such a drain with the outlet shaft of the largest size. If we suppose that the contents of the drain would fill a 4 in. pipe, the 4½ in. shaft would give an area almost equal to that of the remaining empty segment of the 6 in. pipe, so that, roughly, what we have to do is to ventilate a tube, say 5 in. in diameter and 100 ft. long, the greater part of which is horizontal. Even assuming that there are no restricting cowls or gratings at either end, it is manifest that in such a tube there could hardly be any appreciable current without the application of great mechanical force, even if we suppose the tube to be smooth and empty. But the tube we have to deal with is neither. It is rough, and it has for the greater part of its course an exposed surface, greater than that of a 5 in. tube, part of which is in motion in an opposite direction to that which the aerial current would naturally take. In such circumstances it is evident that the current would not only be sluggish but variable, now in one direction, now in another, and often, when opposing forces were well balanced, stagnant. If such be the condition of a drain with a 5 in. air outlet, I need hardly pause to consider the condition of the great majority now in use, which have nothing like so much ventilation.

Of course everything depends on what we call ventilation. If we mean by that term such a change of air in the pipes as is possible under the conditions just described, we may admit that some of our house drains are ventilated; but if we mean by it constant flushing of our drains with fresh air having something like its normal proportion of oxygen, then I fear we must say that none of our house drains are ventilated—with such

restricted sectional area and consequent friction the thing is impossible.

The question then comes to be, can we provide the air space necessary for ventilation without either extending the exposed surface of the sewage or of the contaminated periphery with which the air must come in contact? I venture to think that it is quite possible, and indeed easy, to do so by means of a simple contrivance which I now submit to you (Fig. 1).

FIG: 1.



A. Proposed new form of Drain-Pipe.
B. Ordinary Six-inch Drain-Pipe.

The same quantity of liquid is shown in each.

A drain-pipe such as this may be made of any ordinary size, but assuming that one having the upper portion 12 in. in diameter would suffice, let us contrast it with the drain already described. In the first we had a sectional area for the transmission of air of (omitting fractions) 15 in., in the other you have 120 in.; in the first the surface of sewage exposed is 6 in., in the other $2\frac{3}{4}$ in., assuming that the maximum flow would fill a 4 in. pipe; so that in this new pipe there would be fully a half less exposed surface of sewage, and eight times the amount of air; besides which the flow of sewage would be more rapid being more confined. In such a drain 100 ft. long, open and unobstructed at both ends, the current would not be overpowered by friction, and would hardly be affected by the comparatively trifling area of moving surface; and we by no means advise that it should be open at the two ends only, but at as many points as practicable along its course. Dealing with comparatively pure air we would be at liberty to make intermediate openings without risk—the fresh air would thus have the upper hand and keep it. We can give air as well as water

too much to do, and in fact it is more dangerous to overcharge air than water with impurity.

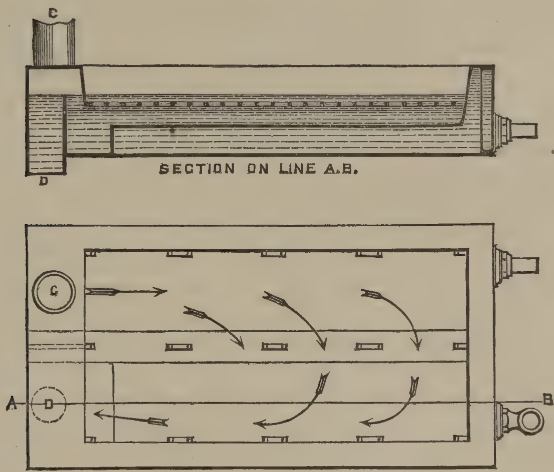
But while I recommend the use of large pipes immediately in connection with the house, that is to say on the inlet side of the manhole and intercepting trap, I must observe, that in most cases it will be advisable to use pipes of small diameter between the intercepting trap and the outfall, especially if that outfall be a common sewer. In that case our object must be to leave no room for air in the pipe—to use pipes large enough to hold the sewage and no more, so that when full or nearly full the air may be expelled from them. I speak of things as they are, not as they ought to be. Our sewers ought to be in a different condition, but while they remain a source of danger the more completely we shut them off from our dwellings the better, and the less we allow their polluted air to remain in contact with the seal of our intercepting trap the better. Where the outfall is good and the branch may be safely ventilated the large pipe of the section shown will be best. In short, the use of the one or the other is indicated by the practicability or otherwise of thorough ventilation.

I must now make one or two remarks on the use of traps in connection with a thoroughly ventilated house-drain. The complete isolation of a house-drain is a fundamental condition. It must not be connected aerially either with a common drain or with the drain of any other house. Having secured that condition by means familiar to you all, and having also secured the thorough flushing of the drain with fresh air and water, it follows that trapping, as a protection against foul air, is unnecessary.

We are practically safe, and the fewer traps we have either outside or inside the better. We do not require to trap soil-pipes, rain-water pipes, or gullies; and by leaving them trapless we only the better insure the purity of the air in the drain. The truth is that by a multiplicity of traps we create a multiplicity of obstructions and deposits, and to that extent interfere with the rapid cleansing and efficient ventilation of the drain. The only excuse for using traps inside at sinks, baths, and the like, is to protect the inmates from cold draughts. For this purpose some obstruction is no doubt necessary, but it need not take the form of a syphon trap. If it does it is most desirable that every trap of the kind should be accessible and cleansable from the vessel with which it is connected. Scullery sinks should be provided with a grease box, which would also serve as a trap ; but it ought to be inside, easily got at, and regularly cleaned by the servant who works at the sink. By appliances at present in use it is impossible to catch the

grease in close proximity to the sink, especially where much hot water is used, but I think the difficulty may be got over by a contrivance which I shall now describe (Fig. 2).

FIG. 2.



C. Pipe from Sink. D. Pipe to Drain.

This consists of a shallow box encased with cold water, and covered with a movable grating resting about half-an-inch or more, according to circumstances, below the level to which the waste water will rise. The casing or jacket is really an expansion of the cold water supply to the sink, and the water in it would therefore be frequently replaced. The contents of the sink entering this box would at once spread over the cold bottom and impinge against the cold sides and raised central division. Much of the grease would rise through the grating and congeal above it, and thence be easily removed, but a good deal would no doubt adhere to the bottom and sides of the box. A depression is made at the end of the box to catch sand or other solids; the size would be in proportion to the amount of work to be done in the sink. It is evident that such a box would be quite easily cleaned, and that the cleaning of it could not be neglected without interfering with the use of the sink; moreover, as it would not be enclosed in any way it would not be out of sight and therefore out of mind.

I shall conclude with a word or two about the trapping of water-closets. The ordinary wash-out closets have necessarily traps which prevent the inconvenient or otherwise objectionable

ingress of external air, but I have no doubt that a good valve closet without any trap is hygienically a greatly superior apparatus. The external air is effectually excluded in this case by the water held in the basin; but it would be *sufficiently* excluded by the valve itself if we assume that the air in the house drain is innocuous; there is therefore no use of a trap in addition to the valve, and without that obstruction the contents of the closet are at once discharged into the drain and carried clear of the house in a few seconds. In this way you not only with certainty get quit of excrementitious matter, but also of water which has been in contact with it; whereas in trapped closets you may get rid of the former but not of the latter, and in many varieties you get rid of neither. It is about twelve years since I first ventured to use trapless closets, and I have recently had an opportunity of comparing some of these, which have been in use for more than ten years, with trapped closets of about the same age, with the following result: in no case was I able to detect the slightest smell from a trapless closet, however long I held the valve open, and in every case where the closet was trapped a most offensive smell was perceptible, if the valve were kept open for a few seconds. All my experience indeed points to this: that our best chance of safety lies in so contriving our house-drains and plumber-work that there shall not be one single receptacle where stagnation is possible throughout our entire system, and that the pure air of heaven shall constantly permeate every nook and cranny of it.

Besides plenty of air and a good scour, and periodical flushing, one thing more is desirable, if not essential, if the contents of our house-drains are to be harmless, and that is that they should be regularly cleaned. I may not enter upon this subject now, but venture to say that I see no difficulty whatever in having this cleaning done periodically at less expense, and with very much less trouble to the occupants of the house, than a somewhat analogous operation to which we are quite accustomed—the sweeping of chimneys. There is indeed no reason why we should not have drain-sweeps as well as chimney-sweeps.

[*This discussion applies to the two preceding papers by* Mr. R. E. Middleton *and* Mr. John Honeyman.]

Mr. Daniel Emptage (Margate) opened the discussion, and remarked that he agreed with Mr. Middleton that the best way to ventilate a sewer was by carrying a pipe from it to the top of every house, though he thought the pipe should be taken as close to the

seal of the disconnecting trap as possible. He also considered that the disconnecting trap should be self-cleansing; but he could not agree with Mr. Middleton that a plain syphon trap was as good as a cascade action. His experience taught him that with the former it was difficult for paper, &c., to pass through unless before a heavy flush of water. He had experimented with them, side by side, with equal quantities of water, and under equal conditions, and found that while the cascade action forced water at once through the trap, in the other the water frequently slipped underneath the paper without carrying it through. With regard to the waste from sinks discharging over instead of under a grating, he might say that he had tried them both ways, and his experience showed him that it was best for the waste to be so fixed that it would deliver the discharge straight on to the seal of the trap, but that the outlet of the waste should be so fixed and tapered off that bad smells from the surface trap could not readily pass up it. The advantage of this arrangement was that there was no accumulation of filth upon the grating. Speaking with respect to Mr. Honeyman's paper, he pointed out that that gentleman said, the only excuse for traps inside under a sink was to keep out a cold draught. To his mind there was a much more important reason, viz., to keep out impure air. They all knew that waste-pipes became quickly more or less fouled, and to have air constantly passing through such channels, was, to say the least, very undesirable. He was sorry to hear the author so strongly advocate those, so-called, trapless closets. He had hoped that, by sanitarians at least, this system had been condemned. If they could ensure such apparatus always being fixed under the conditions insisted upon by the gentleman who introduced them, viz., complete trapping and ventilation of the drain and soil-pipe, and a good flush, they might be tolerably wholesome, but this they could not do. If the closets were made, they would be fixed, either ignorantly or wilfully, regardless of conditions. He had recently removed one which was fixed to an untrapped drain in connection with a cesspool; and upon one occasion he was shown over some large houses at the West End of London in which this system was carried out (the builder being a strong advocate of the arrangement). In connection with the first closet which he attempted to flush there was a defective flushing apparatus, as no water came into the basin, which he found dry and in an unclean state.

Mr. Rogers Field, M.Inst.C.E. (London), expressed his general concurrence with Mr. Middleton's excellent paper. Regarding the ventilation of sewers by pipes carried up the house, he quite agreed with Mr. Middleten, assuming his meaning to be that if pipes were adopted they should not close the openings in the streets, as was often done, which was a great mistake. He also agreed with what the author of the paper said about the use of cast-iron pipes in house drainage. One of the best methods of using these was the one adopted in the United States, where the cast-iron pipes were invariably made to pass under the house and hang along the side of the

wall. This was an admirable plan, as the pipe was always visible, and any defect could at once be detected. He did not quite understand Mr. Middleton when he said, "if there be more than one outlet ventilating pipe connected with the house-drain, then each such portion of drain and outlet ventilating pipe shall be provided with a suitable syphon trap and an inlet air-pipe or disconnecting man-hole." There were cases no doubt in which this might be desirable, but the great thing to be aimed at should be simplicity. To have a multiplicity of traps and pipes would be a mistake. Again, it was perfectly impossible to lay down hard and fast rules: the matter should be left for consideration in each individual case by competent men. As to the question of cascade action with disconnecting traps there were differences of opinion, and he had himself tried a long series of experiments on the subject. The conclusion he arrived at was, that a certain amount of cascade action was desirable, as they could not clear away the paper without it, but that too much was objectionable, as it caused the sewage to splash against the opposite side of the trap. They must judge cases by the peculiar circumstances that arose. Mr. Middleton said that the height of the flushing cistern above any closet, urinal, or slop-sink, should not be less than four feet. This was quite right if they could get it, but there were many cases where they could not, and he consequently did not consider a hard and fast rule desirable in this instance. There were, moreover, many flushing cisterns that would flush the closet effectually at less than four feet. Mr. Middleton remarked that "though there are many bad sanitary appliances in the market, the selection of good ones is a simple matter, requiring little more than common sense knowledge." He could not agree with this, for his experience, which was considerable, taught him that the question of whether appliances of this character are good or bad could only be told by actual test. As one of the Judges of the Exhibition of the Institute since the commencement, he had had much experience in testing closets; but notwithstanding this, he never drew a conclusion as to any new form of closet without practically trying it. Anyone who formed an opinion from merely looking at a closet might find himself very much deceived. Turning his attention to Mr. Honeyman's paper, Mr. Field said the author appeared to start with the idea that they could not get sufficient ventilation in drains to make them satisfactory as they were ordinarily laid. If the author meant by this drains inefficiently laid, as was unfortunately too often the case, Mr. Field quite agreed with the idea; but on the other hand, he was sure they would never find any difficulty in getting a cylindrical six-inch drain thoroughly ventilated, so as to have no smell at all emanating from it if only it were well laid and made perfectly water-tight. This being so he could not see the necessity for the very complicated arrangement Mr. Honeyman proposed, or that there was any corresponding benefit to be derived from it. The author proceeded to say that "having secured that condition by means familiar to you all, and having also secured the thorough flushing of the drain with fresh air, it follows that trapping as a protection against foul air is unnecessary." He

agreed with Mr. Honeyman that a multiplicity of traps was objectionable and should be avoided as far as possible; but could not coincide with him that trapping should be done away with altogether. On the subject of grease traps as ordinarily understood, his experience was, that that contrivance was nothing but an unmitigated nuisance. Each discharge which took place from the sink passed through the grease trap and carried some of the filthy matter from it along the drain, thus causing everything in connection with it to smell abominably. The operation of cleaning a grease trap would never be forgotten by anyone who had assisted at it. The contrivance was, moreover, generally quite unnecessary, its supposed necessity arising from defects in the drains. He had removed grease traps from many large institutions and mansions, and had always found things work satisfactorily without them, as long as the drainage generally was in thorough good order. The next question he had to refer to was trapless closets. He had used them himself many years ago, and they were still working satisfactorily, so that he could not altogether condemn them; at the same time he should certainly not recommend them for general use, as their satisfactory action depended on several conditions which would not be attended to in general practice; in fact, he did not now use them himself except in very special cases. In his last paragraph Mr. Honeyman made a good suggestion about the cleaning of house drains. He did not think there was any reason why they should not be cleaned periodically, just as chimneys were swept, and an arrangement might be made for the workmen who came to clean the drains also to clean the cisterns and look over the whole of the sanitary appliances.

Mr. J. Corbett (Manchester) also remarked upon the ventilation of drains, and intimated that by considerable observation he had come to the conclusion that whatever course they might lay out on paper for the current to pass, it would certainly at times go the opposite way. If they depended upon heat, they must at the same time be prepared for cold, which of course reversed the current arranged by heat. He thought this was a matter sanitary engineers were apt to overlook. He believed a perfectly satisfactory arrangement could be made by a syphon trap without an access manhole, so long as the drain remained in good order; but it seemed to him they ought always to provide for the drain getting into bad order. It should be the custom never to bury any traps without access, either by a direct manhole or at least by tools down an eye. He could quite corroborate Mr. Field's remarks as to the difficulty of selecting sanitary apparatus. He must say that every sanitary exhibition he went to had a depressing effect upon him, because it was usually an insanitary exhibition: and, without excepting even the latest one now open at Bolton, he did think that a great work still remained for the Sanitary Institute in the matter of sanitary exhibitions. So far, at nearly every exhibition he had been to—he thought he had been to nearly all—there was a preponderance of things that ought to be in a chamber of horrors. He suggested that in future a select committee

of the association should be appointed to supervise the exhibits, and be armed with power to let no apparatus be admitted into the exhibition that did not meet with their approval. This done, they would have the great result that, instead of being sneered at as having a small shop show, they would have the thanks of the public, who would then be led to think that the Sanitary Institute could do something for them, and was not merely a tool in the hands of shopkeepers and manufacturers.

Mr. E. C. Robins, F.R.I.B.A. (London), said he wished it to be particularly understood that the papers just read started from two different points of view: one was a repetition of what had been done in sanitary science for the benefit of householders up to the present time, and the other was an original paper which aimed at the introduction of something novel. The author of the latter deserved more commendation than he had received; but at the same time he knew Mr. Field did not discredit original work, and would be happy to see and recognise success when it came. Mr. Honeyman's paper showed a great amount of ingenuity, and if worked out a deal of good might come from the suggestions.

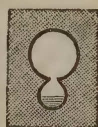
Mr. W. Wilkinson (Bury) drew attention to the paragraph in Mr. Middleton's paper in which he said: "The main soil pipe shall be similarly ventilated, and if there be more than one soil pipe, then each such soil pipe which shall be longer between the basin of the closet and the main drain than eight feet shall be similarly ventilated." He should maintain, in a case of that kind, that every soil pipe should be ventilated irrespective of the length of it, whether it be eight feet or eighty feet. He contended from his experience that traps were a necessity, and also maintained that Mr. Honeyman had himself demonstrated the necessity of traps in his observation that, besides plenty of air and a good scour, one thing more was desirable, if not essential, if the contents of their house drains were to be harmless: and this was that they should be regularly cleaned. That to his mind gave the deathblow to the "no trap" theory, because if there was a necessity for drains to be cleaned, so also was there a necessity for traps to prevent foul air from entering the house. His experience had also been that to allow a slopstone pipe, even if only a yard long, to act as a fresh-air inlet for a house, was certainly a suicidal policy; because if they had such a pipe only a yard long, through which continually passed greasy water, it was impossible to use that pipe even for a week without it being offensive.

Mr. R. E. Middleton, M.Inst.C.E. (London), in replying, said he should not think of having the openings in the street closed, as to do so was most objectionable. Four-inch pipes were no doubt very small for sewer ventilators, but he considered that this form of ventilation was the only one practicable for the purpose. He did not say it was the best, and he should be glad to hear of something better. With regard to using different systems of ventilation in the same set of house drains, if two ventilating pipes were put in the same drain

with one inlet ventilator, he found they counteracted each other, and were equal only to one system where one inlet pipe and one outlet pipe were used, and the inlet pipe would, under these conditions, frequently become the outlet one. In his opinion if more than one outlet ventilating pipe were used it was necessary to have a separate inlet pipe for each, and that each system of ventilation should be separate and distinct. In making the remarks he had done it was of course open to every sanitarian to make objection, and if these objections led to the whole question being sufficiently ventilated, some system which would be generally accepted might be advantageously drawn up. With regard to what he said as to the selection of sanitary appliances, he could quite understand his remarks being misunderstood. He did not mean to say that those things should not be tested carefully, for they should be, but it was easy to find a moderately safe appliance by the simple rules of common sense. If they were able to test them of course it was all the better.

Mr. Harry R. Newton (Weybridge) said: I fear, Mr. Chairman, the time at disposal will only suffice to enable me to make a few remarks, though I had wished to have spoken *in extenso* on this particular question connected with sewering; viz., that air should in all possible ways be excluded from fouled waters: for which purpose I hold that every drain and sewer throughout the kingdom, instead of being nearly empty, and therefore full of air, as they now are (except at storm periods), should be always charged with liquid, always full, always slowly overflowing; in fact, that an absolutely enclosed and arrested rivulet should be created, running over and away in every locality at a higher level than ordinary; so that, besides storing reserved force for the most powerful removal of the contents of any drain, by the usual drain outlet, at any moment desired or required, other beneficial opportunities would arise to take advantage of and to suit any circumstances by which the contents of any drain, or sewer, must in all ways then be under entire control; instead of, as now, the contents of such drains and sewers being left to the chapter of accidents, and remaining without control, restraint or check to the unpleasant, destructive and deleterious properties that fouled waters contain. With reference to animal and vegetable refuse, solid or liquid, the actions of three of the elements on them are definite and distinct in all ways. 1st. *Earth*, by absolutely enclosing organic refuse from the external air, can compel all organism to resume its original condition, its elementary innocuous condition. 2nd. *Water* is, under any circumstances, but a temporary holder of organic refuse, and if then kept from air, retains organic refuse in its then condition without power, *per se*, to reduce that organic refuse to a wholesome condition; but refuse water, in direct connection with air, has enormous powers of making the organic refuse of contagion infinitely more baneful than when in its initiatory state, producing an unhealthiness hitherto next to impossible to get rid of, accumulating as refuse does day by day. 3rd. *Air* has no action on refuse, but what is primarily intensely bad for the health of human nature; for air

attacks vigorously everything with moisture in it; so that everything created by nature may ultimately be evaporated, diffused and given up to it, for its own atmospheric purposes, to be subsequently returned according to the natural and unfathomable laws that control the universe. This natural process of distribution, or action of atmospherical conditions, it is the absolute duty of humanity not to aid or inconsiderately feed with any impurities whatsoever, but where it can and as it can, stamp such unhealthy actions out. Hence, if water is used for getting rid of animal impurities—and which I see no avoidance of for reasons I have given elsewhere—it should *only* and *solely* be used under the following condition, viz.: to be held up at pleasure, and overflow so as to obtain increased power for removal, and to obtain at the same time the actually most favourable conditions and powers for the deodorization, the sterilizing and the destruction of all impurities within its grasp. With the short time at my command, the house drain less requires explanation as to how it can hold liquid and exclude air; but for sewer requirements I can best convey what I desire to do to the meeting, if our friend Mr. Honeyman, who read a paper here this morning, will kindly allow me to explain my views by a reference to the model he has favoured us with and brought here to explain his system for the better ventilation of drains: a condition I am taking the opposite view on. Mr. Honeyman's model shows a quasi sub-drain; that is, a drain with a smaller drain in it at the bottom, not joined in the middle, as the two divisions have a free communication with each other by a horizontal and longitudinal opening throughout: the object being, I understand, to contract a circular space for sewage at the bottom, and provide a permanent air circular reservoir at the top for ventilation. My view is, that it would be better that the semi-division between this dual form of drain should be entirely closed up, so that the two parts be without any connection one with the other; that the lower (the sewage) drain should be always full and running over and away, as before described by me; and that the upper one should be of the size for a man to pass through it easily, and otherwise should be only used for surface and storm waters: the lower drain would then, equally with the house drain, be in precisely the condition required for the artificial correction or sterilizing of all fouled liquids entering therein, and so that, by absence of emission of any deleterious vapour, a source of nuisance and ill-health to humanity may be removed. Though I should like to say a great deal more as to the considerations foreshadowed and as to many details, still I have, Mr. Chairman, in essence, expressed the views I have formed on the sewage question, holding firmly to the definite standpoint, that liquids must



[NOTE BY THE EDITOR.—It is presumed that, in Mr. Newton's case, the pipes would be kept full by the syphon being above instead of below the general level of the pipes. It is to be hoped that both Mr. Honeyman and Mr. Newton will hereafter prepare further details, showing the application of their respective principles to an ordinary London residence of the first class.]

be kept absolutely from all contact with air, so long as they retain, in the smallest degree, any foulness or constituents for fermentation; which fermentation can only arise from the conjuncture of the two elements—Air and Water. On these grounds I maintain that any ventilation whatsoever of fouled liquids or of refuse waters is a fatal error of the most profound character.

Mr. J. Honeyman, F.R.I.B.A. (Glasgow), said he must admit having spoken rather rashly with regard to the absence of traps altogether. Protection from smell was quite as good a reason for using traps as protection from cold draughts. He would not like it to be supposed that he advised the omission of all traps between waste pipes, &c., and the house, although he said that as a protection against air from the house drain they would be unnecessary. He was sorry he could not agree with Mr. Field regarding the necessity of more air in the drain; he thought it could be shown to be physically impossible to ventilate a drain only six inches in diameter sufficiently without mechanical force. Mr. Field said he got a six-inch pipe perfectly without smell; but even if he did he must be aware that a smell was not necessarily a test of the purity or harmlessness of the air. This was a point often forgotten. He would like it borne in mind that his remarks with regard to the doing away of traps were based upon the idea that the house drains were entirely disconnected from the common sewer, and that they were formed and ventilated and kept clean as he had suggested.

On "Health, Comfort, and Economy in Cottage Construction," By J. Corbett, Sanitary Engineer.

In studying this question, and the cognate ones of improving city slums and providing block-dwellings in populous districts, I have inspected the slums of our largest cities, and also their improved dwellings: visited and lectured in many manufacturing towns, and collected plans and useful information from many sources.

The liberal offer made by Mr. William Westgarth, through the Society of Arts, for essays on the best means for providing dwellings for the poorer classes of Central London, induced me to prepare an essay and plans for block-dwellings, to which was awarded in 1885 the premium of £100.

Many of the special features of these plans for block-dwellings are equally applicable to ordinary cottage or small house construction, and so I have embodied them with some modifica-

tions in the following paper, in order to bring them under the notice of cottage builders in this populous manufacturing district.

The recent tendency to return to Old English examples for middle class household furniture, and also for structure and arrangement, may with advantage be extended to cottage dwellings. By judicious modification and adaptation to modern ideas of comfort, many old features of cottage construction may be re-introduced, displacing the shabby imitations of classical architecture which are now the usual features of cheap building.

Before entering into structural details it will be well to consider what are the chief requirements of health and comfort, and what the chief hindrances to attaining health and comfort in cottages or cheap houses.

Health requires ample light, airiness, cleanliness, warmth and dryness in every room.

Comfort requires avoidance of draughts; avoidance of hollow floors or walls forming warrens for mice and other vermin; of weak plaster easily pierced by vermin; of weak floors, creaking and yielding underfoot; of fragile ironmongery, shelving, and other fittings.

Economy requires that the cheapest efficient materials, and the smallest quantity of materials compatible with efficiency, shall be used throughout the structure.

In order to put my suggestions into some definite order, I will endeavour to follow the several trades through the construction of an ideal group of cottages, beginning with the excavators' and bricklayers' work.

The less excavating the better, as a rule, for cottages without cellars. Surface soil should be removed because of its vegetable consistency, and it is generally saleable.

"Made ground" or filled up stuff is often a perilous foundation either for health or stability. A great sanitary authority is reported to have stated some years ago that midden refuse tips were not fit for building upon until *two years* after their formation: and this fatally misleading advice has been repeated again and again by careless writers. Common experience proves that such refuse tips remain foul and give out injurious emanations for scores of years, probably for centuries, after their first formation. In my opinion the only structure for a house floor on such a site compatible with health, comfort, and economy is that of raising the house floor two steps above the surface level, and covering the site with half-brick arching and a coat of pitch; thus providing for free ventilation between the foul ground and the floor, and preventing any direct emanations

from the ground into the house. The bricks used for these arches and their foundation walls may be of inferior quality and rough shape.

The outer walls need not be more than one brick (nine inches) in thickness. The great majority of middle-class houses in Lancashire have walls only this thickness, and it must always be remembered that to insist on a needless thickness of walls is to insist on a needless burden of rent caused by their extra cost.

The outer facing-bricks must be of hard, impervious quality, and this for many reasons.—They will thereby prevent rain from soaking through to the rooms.—They will avoid liability of the bricks to bursting by frost and thaw.—They will retain their warm colour, not becoming either mossy or soot-stained.—But most important of all, they will keep the house warm by avoiding taking in moisture and gradually evaporating it out again, a process similar to that of a porous water carafe, by which the inside temperature is made many degrees lower than the external air.

Where the bricks are not sufficiently impervious, they may be protected externally by a couple of coats of boiled linseed oil, laid on hot while the walls are dry in summer time. Mineral oil or melted wax will also answer the purpose.

Stone walls may be similarly benefited by two coats of Portland cement wash, of the consistency of cream: and this may be slightly tinted where so required.

The most serious false economy commonly made in connection with external walling is the omission of overhanging eaves in all but the front walls. By an overhang equal to only one-twentieth of the height of a wall, about nine-tenths of the rainfall may be kept off it, and its dryness and warmth materially increased. At the same time such overhanging eaves on all sides give a much enhanced appearance to the house.

Cavity-walls are advisable where much exposed to driving rain, or where bricks are somewhat porous; but they are objectionable as forming harbours for vermin, and also means of airway and possible contagion between adjoining houses.

Artistic effects scarcely come within the range of this paper, but as comfort is certainly promoted by tasteful appearance, I may call attention to the excellent effects attainable by suitable corbellings, arches, salient courses, and other very inexpensive uses of common bricks, infinitely preferable to the patches of wrought stonework or fancifully coloured brickwork, often used as decorative features on cottages.

The smoke flues offer an opportunity for considerable economy and increase of comfort. We usually see similar flues, 14 in.

by 9 in., applied to the huge kitchen range of a mansion and to the little fireplace of a cottage. For a cottage such a flue is most inconveniently large; it is too large to heat, and therefore draws poorly, while in windy weather it causes an excessive draught through the room. A flue, 9 in. by 7 in., is large enough for a cottage kitchen or bedroom; it will draw better, and require less sweeping than a larger flue. It has been objected that by retaining less soot it evidently discharges more soot than a larger flue, but any such tendency is more than balanced by the great economy of fuel resulting from the avoidance of irregular and excessive draught.

By reducing the size of flues, the bulk and cost of chimneys is materially economised.

In connection with smoke-flues, I strongly advise the provision of vent-flues from the upper part of each dwelling room or bedroom. None of the outlet valves, from Dr. Arnott's original type down to the latest so called "improvement," will practically work satisfactorily; but a much simpler and cheaper appliance has long been proved efficient. This is simply a short vertical tube, 4 or 6 in. in diameter, built into the chimney breast or else placed beside it, open at one end to the room near the ceiling, and at the other end into the smoke flue close to the fire-place. A regulating valve may be added if desired; and it is well to have a damper or fire-board to close the fire-place opening when out of use, so as to cause the whole draught of the flue to act in extracting the hottest and least pure air from the room, thereby having an important advantage over ventilation by the fire-place, which carries off the lowest strata of air, the coolest and purest in the room.

An important economy of space may be effected in cottage parlour or bedroom fire-places by setting back the grate, &c., some six inches within the projecting chimney breast, turning the flue from the fire-place directly sideways into its smoke flue, and forming an arched recess over the mantel, deep enough to contain shelves for ornaments, &c. A similar recess may be made over a cottage kitchen range, where bright pans, &c. can be kept.

For flooring of kitchens and sculleries flagging is a very cheap and durable material, but coloured tileing on a good concrete bed is far preferable in appearance, and but little more in cost. It is much cleaner and freer from chinks and cavities than boarded flooring, thereby reducing the usual liability of kitchens to mice, cockroaches, &c.

Popular taste will scarcely tolerate yet the use of hard brick window cills and door steps, in place of the stone ones on which the cottage housewife expends so much bath stone and needless

work: but economy, in this brick making district, should induce a preference for hard bricks set in cement for cills, &c.

In districts where stone walling is as cheap as brickwork and equally dry, it may be used with great advantage in appearance; and here again it will be well to study the bold and effective artistic features produced with almost unwrought stonework in many old buildings; the adoption of such homely features, being much more suitable than the attempts at rich mouldings and even carvings found on some modern stone cottages.

Turning now to the carpentry and joinery, the most important question is the best form of flooring.

The common system of scant one inch boards on joists at 16 in. centres has many serious faults, and I think that a modification of the plank flooring commonly used in warehouses would be far preferable.

For upper room floors in cottages, it would be usually a saving in cost to adopt plank flooring properly arranged. The width of room seldom exceeds 12 ft., and 3 in. planks would suffice for this bearing if well tongued and bolted together. By using $3\frac{1}{2}$ in. or 4 in. planks, a very stiff and strong floor would be made.

Each room floor could be completely prepared in the workshop: the separate planks machine-planed, squared and grooved: two one-inch bolt-holes bored laterally through each plank: iron tongues inserted in the grooves: bolts inserted from side to side of the set of planks and screwed up tightly: the surface finally dressed off, and the complete slab of flooring conveyed to its place and laid down on salient courses in the room walls prepared to receive it. In many cases it would be more economical to make each room floor in three pieces, joined together by an under board and coach screws. The shrinkage could be easily taken up by tightening the through bolts. The chink round the walls would be flushed with cement; and thus a strong, warm, draught-proof and vermin-proof floor would be made at a cost not exceeding that of a common floor and plaster ceiling. Such plank floors are more sound-proof than ordinary floors; they also save about one step in each flight of stairs and in the height of the walls. For the ground floors, usually supported on sleeper walls four to six feet apart, two-inch plank flooring, grooved, tongued, and through bolted, would be much warmer than the usual one-inch boards on joists, and very little more costly.

A similar economy of space and materials may be effected by forming slated roofs on grooved and tongued boarding, carried on purlins, &c., at from four to eight feet span, without any roof spars. Very light boarding will suffice where inner ceilings

are used; and where the roof forms also the ceiling, $1\frac{1}{4}$-inch boarding with roofing felt under the slating forms a warm and draught-proof structure at a moderate cost. Like the solid flooring it has the important advantage of not harbouring vermin.

One of the weakest and most troublesome fittings in a cottage is the panelled door, with its casings, mouldings, lintel, wall-plugs or nogs. I suggest a means of simplifying and solidifying this complicated structure by forming the casing and mouldings of Portland cement, just as external cement mouldings are formed. The door hinges and lock plates to be screwed to fixing-blocks built at definite heights in the walls.

Window casings and mouldings for hinged or sliding casements might be similarly made of Portland cement.

Wood lintels and bond timbers, which often injure a wall by shrinking, and thus causing settling cracks, may be advantageously replaced by very light $4\frac{1}{2}$ in. rolled iron joists, laid flat, so as to bond the brickwork. These would suit well to the cement casings above described.

Wood skirtings would be replaced by cement with the same advantages as above described for door and window casings and mouldings.

Wood shelving should be replaced by light cast iron, protected by the Bower-Barff process of bi-oxidation, to prevent rust: and these shelves could be directly built into the brickwork.

Plastering of walls should be substituted by a thin facing of cement, the brickwork being more evenly set than usual, so as not to require much thickness of cement to form a true surface. This cementing would completely prevent any piercing by vermin.

The interesting examples of ideal furniture and structure for cottage homes exhibited in the present Manchester Exhibition, in the Manchester Art Museum in Ancoats, and at other exhibitions, give many excellent hints for practical use; but too often they are cumbered by fantastic cupboards, tables, &c., that would ill stand the trial of rough every-day use.

Still, we may hopefully notice that the rapid spread of education and a higher civilization among the working classes, is fostering in them a taste for more elaborate cottage furniture, and this improved taste warrants the introduction in cottage building of refinements and elaborations which but a few years since would have met with no appreciation.

The ordinary coal fire cooking range is still most popular, but the addition of a strong jointed gas bracket with a large burner to swing into the oven, thereby providing a useful gas

oven when the coal fire is not in use, would enable an early breakfast to be prepared, or a Sunday's dinner cooked without risk of burning while the house-wife was out.

Wherever cottage dwellings are massed in large numbers, and especially where they are built near a manufactory using steam boilers, it would promote health, comfort, and economy, to supply a limited amount of steam heating to each cottage by means of an oven enclosed in a steam casing in communication with flow and return pipes from a steam boiler.

Each oven should be about 14 inches cube inside, with an ordinary iron door; the oven enclosed in a 15-inch cube; the intervening space constantly filled with superheated steam at a moderate pressure, so as to maintain an ample heat for boiling in the oven. This arrangement would prevent any waste of steam, while yet providing an ample heat for the following services:—

On rising early in the morning a hot breakfast could be prepared without waiting to light a fire. A can of water could be heated for washing the pots, the floor, &c. On washing days the clothes could be boiled and presently aired or dried. Dinner might be completely cooked with ample variety, including boiling or stewing, and baking of puddings, cakes, or bread; these last only requiring a finishing browning, which would be effected, as would the roasting of meat, &c., by lighting a large gas jet to supplement the steam heating of the oven. The room might be sufficiently warmed during cool evenings by opening the oven door, and thus letting hot air circulate into the room. Tea or coffee could be most perfectly prepared. Hot water for an evening bath for either children or parents might be provided; the scullery or a bedroom being used as a bath-room. Infected or unduly inhabited clothes might be purified without risk of burning them.

All these advantages might be provided at half the cost now expended in fuel, by the well-known economy of having one large fire properly used in a furnace, instead of many small fires wastefully used in open grates, which also involve much dirty work and waste of time. Domestic fires being thus almost superseded, the smoke nuisance would be reduced to a minimum, and thus cleanliness, culture of gardens, enjoyment of the open air, and many other advantages would be secured.

Almost every town cottage in this district has a constant supply water tap placed over a slopstone in its scullery. It would be a great improvement to replace the porous and rough-surfaced slopstone by a glazed earthenware washing-sink, capable of being kept clean and sweet.

As to closet arrangements, it is not difficult to construct

simple and efficient tub-closets, but after inspecting thousands of cinder-sifter and other such closets, I conclude that they are not satisfactory with ordinary careless and rough usage. I am strongly of opinion that simple hopper and trap water closets are the least objectionable and most economical appliances for their purpose.

Time does not permit of my entering on other departments of cottage construction, though the subject is of such extremely wide interest as to encourage its complete discussion; and I conclude with the hope that these suggestions, and the accompanying drawings, may result in some practical improvements in the homes of the working classes.

Prof. T. Hayter Lewis, F.R.I.B.A. (London), said this paper was upon a subject which in reality affected them all very deeply. A person going through the country places in which he was a stranger, had often pointed out to him the grand mansions in which the wealthy classes lived. It often happened they could not see the mansions from the roadside, as they were generally hidden in the midst of parks, gardens and trees; but what they did see, fringing the road and giving a tone to the whole country, were the homes of the working classes. They could not take up the writings of any domestic English poet without finding that he drew his inspiration from the cottage homes. He would now request the many gentlemen present who were so competent to discuss the subject, to furnish some comments on Mr. Corbett's excellent paper.

Mr. J. J. Bradshaw, F.R.I.B.A. (Bolton), said he had taken down a few notes whilst Mr. Corbett was reading the paper. He must thank Mr. Corbett for having taken the trouble to bring this matter forward, for it affected the bulk of the population far more than most subjects dealt with by the Congress. The first note he had made was as to the couple of coats of boiled linseed oil. This substance evaporated, and a better plan was to use a solution of wax. In addition to that, oil discoloured the bricks, and the other substance would not do so to the same extent. With regard to the arrangements shown on the diagram for small flues for cottage ranges, he was afraid they would not always answer. The arrangement of the side flue for the air vent was nice and effective. Tiling was suggested for kitchens and sculleries, but the objection to it in this district, where flags were reasonably cheap, was that tiles were much colder to the feet than flags. The brick available in this district was very porous, and if used in sills led to a more speedy rotting of the woodwork. There was one little remark he must object to. Mr. Corbett suggested that the flooring should be made up complete, and then taken to the place and put in. The exigencies of building suggested one remark from him. He was reminded by Mr. Corbett's suggestion of the man who made a cart in

his bedroom and then, after finishing it, found that he could not get it out. Then again, if the flooring were made as suggested, the wood would be green and the shrinkage of the timber after a little lapse of time would leave it open at the joints. The same remark applied to the roof boarding. He had done it often enough in the erection of sheds, but to use that method in a house would cause the joints to become open in a very short time. He was not quite satisfied with the idea of hanging hinges to anything prepared in the way suggested, because the fixing blocks would have to be of wood, instead of patent cement blocks; and in the event of wood, which was ordinarily the case, they would soon shrink and become loose. He was glad to see that wood skirtings were recommended to be replaced by cement. Even the speculative cottage builders in this district had adopted that plan, both for bedrooms and kitchens. The plastering of walls with cement was a good idea; but the objection to it was that of expense, as cement was more costly than ordinary plastering. The only objection to the glazed earthenware washing sink was that they were liable to crack. Any one who would take the trouble to walk down a back street of cottages where pails were in use, as in new property in this district, would go away with the idea that something ought to be done, as the stench was intolerable; and if the water-closets were used, it would be better, especially as there was such a good water supply in this district. There was no question that the hopper and trap water-closets were the best for the immediate removal of excreta from the premises.

The Rev. Canon Atkinson, M.A., D.C.L., (Bolton), said he did not rise to make any observations upon the paper, but to express his great satisfaction that this subject should have come before the Congress. There was no subject which in these days was more important. The great enemy, both of the owners of cottage property and the tenants, was the jerry builder; and if they could only get good substantial houses built which were healthy, comfortable, and economical, a great problem would have been solved. As to cavity walls, all he knew of them was with regard to rats: if cavity walls were dispensed with, then they would have one less resort for the rats. As regarded coal fires, many of them had been abroad and had seen the miserable fires there; he did not think they would get the working classes of England to do away with coal fires. Gas ovens, however, would prove very valuable and useful to inmates of cottages. He should like to ask Mr. Corbett if he could give any idea of the cost of a cottage, or a row of cottages carried out on his principles.

Mr. W. R. E. Coles (London) said he should like to ask a question as to the steam cookery spoken of, for he understood Mr. Corbett to say that the advantage it possessed was that it prevented overheating; this would depend upon the amount of pressure under which the steam was generated. He also asked Mr. Corbett to explain the use of a certain recess shown in one of the diagrams.

Mr. J. Corbett (Manchester), in replying to the discussion, said that Mr. Bradshaw spoke of wax solution as being better than oil. He should like to know whether that was the new mineral wax or the common beeswax?

Mr. Bradshaw—The mineral wax.

Mr. Corbett said that might do, as the mineral wax was getting cheap now. He might explain with regard to the bricks, that the best obtainable in Manchester, which was very near to Bolton, were not porous, but good and hard. As to the floors, he did not propose to build the bedroom before placing its floor; a small travelling crane would answer the purpose of raising the floor. As to the alleged greenness of the timber, he did not know why they should be compelled to use green timber, and if it were well seasoned before being placed in position, he had had the contrary experience to Mr. Bradshaw; for he had known the floor to burst upwards because it was too dry. The subsequent moistening of the timbers from new plaster, &c., had caused this. Having been asked whether he had practical experience as to his plan being workable, he might say that with regard to cottages, it was still in the range of theory; but he had quite enough experience as to plank flooring to give him an assurance of its practicability. As to the cost of a cottage carried out on his principles, he took it that it might not be materially more—not more than ten per cent. more—than the ordinary cottage. With regard to the cost of cottages, he had known them built for £57 and £70 each; but for a well-built and tolerably good cottage, he did not think they need go below £100. In answer to Mr. Coles, he thought the temperature of the steam they would use would not burn anything, and practically he was warranted in saying that overheating would be prevented. It was very easy in building a house to make a recess over the mantel-piece, turning the flue quickly aside; he took it that it would be very easy, and that it would pay to do it, simply because it would be less costly to make the cavity than to fill it with brickwork.

Mr. Corbett was then asked if he proposed that the flooring when put in in one piece should be used as a scaffold, because that would injure it.

Mr. Corbett replied that he should recommend the flooring to be covered with loose boards to prevent damage.

Professor T. Hayter Lewis (London) then closed the discussion. He apologized for curtailing the discussion, because he thought it was a subject particularly interesting in this district; it was also a subject which was highly interesting to him personally. Nevertheless as the next subject which was to be brought forward—that of Smoke Abatement—was of special interest in this town, and the time for reading the papers on it was now very limited, he had felt obliged rather to shorten the discussion upon Mr. Corbett's paper.

On "Smoke Abatement," by HERBERT FLETCHER.

To Members of the Institute, who are probably surprised at the dirtiness of a town, that invites them, it must appear either, that dirt is thought to be sanitary, and that the town is therefore proud of it, or that it wants to be shewn how to clear it away, and seeks their assistance.

In both these opposite conclusions they will be right; for opinions are divided between the two, or, at least, interests are, and they sway opinion.

The smoke is the cause of the dirt, not the domestic but the manufacturing smoke. The difference is shewn on Saturday afternoons and Sundays, in the air, but the weekday soot of the big chimney remains spread over everything, and it is this which gives a character of hopelessness to every attempt to redeem a manufacturing town from that condition which causes it commonly to be contemptuously described as that "vile hole."

But, we are told, that the dirt is wholesome,—that the soot is a disinfectant,—and, that the gas, into which it should be converted by complete combustion, is more noxious;—that its prevention, although required by law, would be a tax on employers, and a hindrance to trade; and, that the dirt by debasing the conditions of life lowers wages, by which lowering every one profits, except perhaps the workman himself.

The last argument should need no answer; it amounts to an advocacy of an injustice to the producers in the interest of the consumers. As to the prevention of smoke being a tax on employers;—if the right means are adopted, and of these means hereafter, its prevention is remunerative,—as there are many examples to prove.

The soot if consumed forms a gas, which is that constituent of pure air upon which all vegetation depends for existence, and its consumption does not at all affect the quantity of sulphurous acid gas produced, the quantity of which depends entirely on the sulphur in the coal. This sulphurous acid is carried further away and is harmlessly diluted, in proportion as there is less solid soot to absorb it and drag it down to the ground. This is the gas which does the mischief, and it is the black part of the smoke—the soot—which by its every particle prevents the

sulphurous acid from obeying the natural law of diffusion in the boundless space of air above.

There remains now only the first assertion unanswered—that the soot is a disinfectant, a smell destroyer—and does the work of the public distributor of disinfecting fluid, and this at less cost than he can.

Could this be established, we could still claim a right to choose between the rival disinfectants, and might prefer to trust for the prevention of disease to the removal of its causes rather than to either Condy's fluid, or to smoke.

Here the Sanitary Institute can help us by showing whether by the prevention of the smoke we should lose a friend, and not only a friend, but one we cannot replace. Sixty per cent. of deaths in the borough of those above five years are from diseases of the lungs. It cannot be denied that smoke is an irritant; yet, if it can be shown that deaths from fever will increase more, than those from bronchitis will diminish, should the existing law be put in force effectually against the tall chimneys, they, in whose power it lies to enforce the law, may hold their hand awhile, till the causes of fever, which require the smoke as a disinfectant, are removed.

The sanitary staff of this borough, however, will not allow things in their department to come to such a pass as this, and, unless it can be shown that the smoke is nourishing, there should remain no reason for tolerating it, beyond the difficulty of burning coal without making it. That coal can be so burnt, there is ample evidence in all parts of the country; and there are several makers of efficient mechanical stokers and perfect smoke preventers, who can provide anyone, whose chimney is complained of, with the means of entirely, not partially only, discontinuing his nuisance. A mechanical stoker or machine fire grate is necessary, for, though hand-firing *may* raise steam without smoke, the circumstances have to be very exceptional;—the draught must be strong,—the coal must be of first-rate quality,—well screened,—and of uniform sized lumps, so as to permit the passage of air;—the coal must be allowed to coke on the dead plate of the boiler, and part with much of its gas before being pushed forward on to the incandescent fire upon the bars,—the fires must never be pressed,—and, there being thus a slower rate of combustion, the number of boilers required for smokeless hand-firing will be greater, than where there is no check imposed by the authorities on the commission of the nuisance.

A few years ago, in order to show to the Admiralty that the Lancashire coal could be burnt economically and without smoke in the Navy, a boiler and testing plant was erected at Wigan,

and it was proved to their satisfaction that this could be accomplished by ordinary means without the assistance of machinery. Most careful firing, however, was required, and the fireman, who was an expert, had only one boiler to attend to. Where ordinary small and "dirty" coal is used, that is, fuel containing over 20 per cent. of shale and fireclay too minutely divided to be separated except by the process of "washing," and where the utmost power of which they are capable has to be got out of the boilers, as is generally the case, it is necessary to stir the fires continually, and to spread the fuel thinly over the whole area of the grate. Each of these operations is attended by a suddenly increased yield of gas, which by its own volume checks the inlet of the very air, of which, in order to produce perfect combustion, a suddenly increased supply is required, nine times in excess of the sudden increase in the volume of the gas.

Every particle of gaseous carbon in this suddenly increased yield of gas that is then unable to find the oxygen supplied by the air, cools down without developing the heat it otherwise would have done in combining with that oxygen, and in forming the colourless carbonic acid gas, which is the result alike of all combustion and of our own breathing, and becomes solid and black, and appears as a particle of smoke floating from the chimney-top in the volumes of gas, whose chemical combinations have been completed, and of whose existence there would be no coloured evidence but for these particles of solid carbon.

It is customary to abuse the firemen for the smoke; but except with an unusual amount of boiler power, permitting slow combustion, and also with such an unusual quality of fuel as admits of being coked at the front of the fire, he is powerless to prevent it.

Neither are all mechanical stokers smoke-preventers. They may be comprised in two classes. Firstly, those by which the fresh fuel is thrown on to the burning fuel over the whole area of the bars like hail; and, secondly, those by which the fuel is slowly introduced, and coked, as it is passed forward over the bars, with a movement comparable to that of a glacier down a valley. Those of the *First* class are useful chiefly for increasing the evaporative power of the boiler:—they enable a larger quantity of fuel to be burnt in a given time;—they relieve the attendant, not of the feeding but of the spreading of the fuel:—the intermittent discharges of dense smoke do not occur, as might be expected,—the feed being continuous; but where the fire has to be urged by the poker, or the burning fuel has to be levelled or arranged by the rake, the use of this class of stoker is attended by but slight diminution of smoke;—of these facts

there is ample evidence in the borough and neighbourhood. If the clinkers and ashes have to be withdrawn at the front from off the bars, the labour of the attendant is not lightened by their use :—they afford easy access to the fire—an advantage which is abused, where boilers are over-fired, by the constant introduction of the poker :—they cost from £10 to £30 per boiler more than hand-firing apparatus, and this small difference, together with the facility for urging or over-firing, are probably the chief causes of their having the larger sale :—they effect an economy in fuel ;—but their claims to smokelessness depend for realization on their not being urged, and on their being combined with self-cleaning bars.

The distinguishing feature of the *Second* class of mechanical stoker is, as was said, the glacier-like motion of the fuel imparted to it by the movement of the fire-bars ;—like the stream of ice so does the stream of fuel gradually evaporate and grow thinner in its progress, and both alike give up their earthy matter—the one its stones—the other its ashes, as they disappear. The ashes fall from off the inner ends of the bars, and are removed without interfering with the fire. The thickness of the fuel on the bars depends either on the height of a door or shutter, under which it is drawn by the movement of the bars, or on this movement combined with that of pushers at the front.

These machines perform perfectly that work of the attendant in coking, which is required, as was said, for smokeless hand-firing ;—they cannot be so easily urged, as can the first-class ;—but are quite smokeless and economical ;—they are specially adapted for inferior fuel, as they render easy the cleaning out, which with ordinary steam-fuel constitutes the hardest part of the work.

Imparting motion to the bars, which are the heaviest parts of the apparatus, renders the machines of this class more massive than those of Class I., and their first cost is about twice as great; but without this motion of the bars mechanical firing is simply mechanical feeding, and for the object of smoke prevention is a useless compromise. The machines used by the writer are of this class. Six of them have been in use for eleven years at the Ladyshore Colliery, and three have been lately erected at Farnworth Bridge, where those interested will be always welcome. The fuel used is of the poorest description, —firing by hand with it was impracticable from the labour required in continually stirring the fires and cleaning out, yet with the machines the rate of combustion is from 20 to 30 lbs. of fuel per foot of grate surface, or 8 cwt. per hour per boiler ;—the evaporation 900 galls., or 10 lbs. of cold water raised to steam

of 80 lbs. pressure per pound of slack;—there is absolutely no smoke, or, to put it scientifically, the resulting gases contain no soot. And, finally, the labour of the attendant is greatly lightened. The cost was £100 per boiler, and the repairs are inconsiderable. It is not maintained that these machines are the best; but merely that they prove the entire prevention of smoke to be both practicable and economical.

Taking the difference between the cost of such a machine and a hand-firing furnace at £70, and, considering that one first-class boiler will drive £40,000 worth of modern mill plant, the percentage on the capital required to prevent the smoke nuisance is too small to be pleaded in excuse for breach of the law, and the infliction of a public injury;—neither can ignorance be pleaded as an excuse, yet the new mills are amongst the worst offenders! What is to be done?

A town council determined to enforce the law could remove the smoke nuisance and obtain everybody's blessing in a year or two, and they would be irresistibly urged to that course, if it were known by the municipal electors how practicable is the remedy for the evil of which we are ashamed before you and all strangers.

If our magistrates, themselves often smoke makers, will not fine more than 10*s.* after all the trouble the nuisance inspectors have to take to obtain a conviction, we might perhaps get such cases removed beyond local influences to another court. It is probable, however, that authorities will lean to public opinion, and if they have evidence that those who live in and near the borough really desire a change, they will procure it for them. There would be no opposition to an earnest majority of the Council, who would appoint a smoke inspector, and support him faithfully.

It was to push this grievance to the front, that the writer was asked to stand for a ward of the Borough, and the election of a few more to help in the same cause would soon turn the scale in the corporation of a town, where we are all naturally afraid of treading on each others toes. The subject is not a favourite one with the Sanitary Committee, and is not likely to receive attention till it becomes a plank in the local political platforms. We all dislike compulsion, and a premium on sanitary boiler plant might be better and be well laid out money, and such "coaxing be better than scratching." Compulsion, however, or inducement of some kind, is necessary, as, without it, it will not be worth the while of any firm to make the necessary changes. A proposal to do so by any manager on public grounds alone would be rejected as a sentimental use of their shareholders' money, by many directors, who, as private citizens,

are liberal enough;—moreover, the effort would appear useless to any one firm surrounded by careless neighbours. Improvement seems now to consist only of extension, but, as we grow bigger, we grow dirtier, and the outlook for those who have no prospect of early retirement from the "vile hole," and are not by that prospect rendered indifferent to everything but cash profit, grows blacker and blacker. If we do nothing, we increase the difficulty for those who follow.

[*For discussion on this paper see page* 335.]

On "Smoke Abatement," by D. J. RUSSELL DUNCAN.

Existing Acts of Parliament, their defects and omissions, enactments and penalties, qualifying clauses relieving persons who create smoke nuisance from the necessity of consuming *all* their smoke.

Omission from the Acts of domestic fireplaces. Exemption of Glass Works and Potteries from Act of 1853. Repeal of the Act in 1856. Extension to steam vessels plying to the Nore in 1856.

Inclusion of Baths and Wash-houses.

Power granted to Local Authorities to institute proceedings under Local Management Act, 1855. The Sanitary Act, 1866.

Lord Stratheden and Campbell's Bill: Necessity for enlarging Metropolitan Area.

Evidence before Select Committee of House of Lords on Lord Campbell's Bill.

Usual practice adopted by Metropolitan Police when commencing prosecutions.

Railways not under any restrictions for Smoke Nuisance.

Hotels and Eating Houses not affected by existing laws.

Donkey Engines on board vessels evade the laws.

Counsel's opinion anent same, S.S. "Era" case.

Magistrates as offenders. Police prosecutions in Bolton. Supplement No. 1. Copy of Regulations from the Bolton Corporation Act. Communications from Provincial Authorities. Supplements Nos. 2, 3, 4, 5 and 6.

Application by National Smoke Abatement Institution to Home Secretary.

Police and other Reports—inadequacy of fines imposed.

Improvements in Smoke Consuming Apparatus for industrial purposes. Particulars of official tests conducted by Mr. D. K. Clark, the Testing Engineer to the National Smoke Abatement Institution. Supplement No. 7.

Improvements in Domestic Apparatus.

Progress in Inventions during last 10 years.

Fuels—solid and gaseous.

Functions of the National Smoke Abatement Institution.

Unhealthiness arising from fogs.

Smoke abatement is a subject of so comprehensive a character that it will be impossible at the present time to deal with all its numerous and important points, and in introducing a paper under this heading to the Sanitary Institute Congress, it is merely hoped that it may be of some service in directing public attention to some of the chief points, and forming a basis for the useful discussion of the subject.

The subject daily becomes of greater national importance, on account of the increasing number of industrial works, and also to some extent in consequence of the increase in population.

In towns, this matter is of the greatest importance from a sanitary point of view. Scientific evidence has demonstrated that dense unhealthy fogs, such as are frequent during the winter in London, are due to the large volume of solid particles floating in the air, which promote the condensation in the atmosphere under certain conditions of pressure and temperature. The presence of smoke in the air intensifies its impurity, adding to the normal volume of dust to be found in large towns great quantities of soot, carried through the chimneys of furnaces and domestic fireplaces.

The existing Acts of Parliament which chiefly control the emission of smoke in London became law in the years 1853, 1856, 1866.

No. 1. An Act to abate the nuisance arising from the smoke of furnaces in the Metropolis, and from steam vessels above London Bridge. 20th August, 1853.

No. 2. An Act to amend the Smoke Nuisance (Metropolis) Act, 1853. 29th July, 1856.

No. 3. An Act to amend the law relating to Public Health. 7th August, 1866.

They are incomplete in many ways. No attention was given, at the time the Act of 1853 was framed, to the nuisance created by steam vessels (except those above London Bridge), and, with

regard to this Act, which applies to London, the area defined has long since been exceeded, numerous cases of smoke nuisance having arisen from the many industrial works that have sprung up beyond the limits prescribed, with which the Act is powerless to deal.

This Act of 1853, stipulates that every furnace "shall be so constructed as to consume or burn the smoke arising from such furnace," and goes on to say that every person offending "without using the best practicable means for preventing or counteracting such smoke," shall be liable to a penalty of not less than forty shillings, nor more than five pounds (£5) upon a summary conviction; upon a second conviction, a sum of ten pounds (£10); and upon each subsequent conviction a sum double the penalty imposed upon the last preceding conviction. This applies also to all steam vessels on the River Thames above London Bridge.

This Act, if it had no qualifications, would no doubt have been of greater value over the area of the metropolis as defined at the time, had it not contained a clause which has tended to render it, in a great degree, inoperative, and which says, in reference to the enactments already mentioned—"Provided always that the words 'consume or burn the smoke' shall not be held in all cases to mean 'consume or burn *all* the smoke.'" Also that the Magistrate is empowered to remit penalties in cases where he is of opinion that the persons summoned, have constructed or altered the furnaces so as to consume, as far as possible, all the smoke arising. Nothing whatever is said in this Act about regulating the emission of smoke from domestic fireplaces, or from hotels, clubs, &c.

The Act also contained a clause exempting glass and pottery works, already existing at the date of enactment, but this was repealed by the Act of 1856, and the same Act also extended the power of the Act of 1853, to all steam vessels plying between London Bridge and the Nore.

The inclusion of "baths and washhouses" was made to the list of buildings enumerated in the Act of 1853. This Act also authorised the Secretary of State or Commissioners of Police for the Metropolis and City of London to take proceedings against offending parties, and this power was extended to the local authorities by the Act for the Better Local Management of the Metropolis, in 1855.

The Act of 1866, called the Sanitary Act, covered the nuisance resulting from all fireplaces and furnaces used within the district of a nuisance authority for trade purposes, but it carefully excluded the chimneys of private dwelling houses. It also authorised a magistrate to dismiss any case where he felt

satisfied that the fireplace or furnace had been constructed to consume smoke as far as practicable, or had been carefully attended to by the person in charge.

Lord Stratheden and Campbell some time ago introduced a Bill into the House of Lords "to amend the Acts for abating the nuisance arising from the smoke of furnaces and fireplaces within the metropolis;" the object of which was to empower local authorities to make bye-laws prohibiting and regulating the emission of smoke from buildings, whether industrial or domestic.

This Bill was introduced after careful enquiry had been made into the state of the existing laws. It was found that urgent necessity existed for enlargement of the metropolitan area, as cases had arisen at Hammersmith, and elsewhere in the suburbs, creating great nuisance, with which the Acts in force were powerless to deal.

Numerous factories in the East-End of London cause great discomfort to the poorer public inhabiting that district, who are comparatively powerless to protect themselves against such nuisances, and who have also difficulty in bringing them under the notice of the authorities.

It has been argued that potters' kilns cannot be fired without emitting smoke; but that this idea is erroneous has been proved, to mention one instance only, by the arrangements adopted in Staffordshire, whereby Messrs. Minton's potteries have been rendered smokeless.

The evidence brought before the Select Committee of the House of Lords to consider the Smoke Nuisance Abatement Bill contains much valuable information upon the defective legislation, to remedy which is the purpose of Lord Stratheden and Campbell's Bill.

Regulations exist in Paris restricting the production of smoke by domestic dwellings, and a similar legislation ought to be practicable in this country. The thing can be done, and might be enforced without creating any great expense, and in such a manner as not to depend upon the persons attending to fires, who are often careless and negligent. Time fails for a full description of the various enquiries that have been made into this subject, but they were minute and careful, and the results may be fonnd in the Report from the Select Committee of the House of Lords on the Smoke Nuisance Abatement (Metropolis) Bill.

The Report explains the usual practice adopted in the metropolis when smoke is observed issuing from a manufactory. Notice is given to the occupier of the works, and, if the nuisance is not abated within a reasonable time, a second notice

is sent; if still unabated, the engineer appointed by the Home Secretary to examine furnaces against which complaints are made, is apprised of the nuisance—he inspects the place and reports to the Commissioners of Police, and, when proceedings are taken, attends on behalf of the Home Office to support the proceedings, and advise the Bench on the technicalities of the case.

The Report also shows that railways are not under any control, excepting that of the Railway Clauses Consolidation Act, and practically the clauses of that Act relating to smoke are not worked at all.

The effect of new legislation, so says the Report, would be to bring railways, and all other sources of smoke, under some sort of control, and proceedings could be taken by local authorities. The evidence also shows that the law, as it stands, does not adequately control or prosecute hotels or eating-houses, unless steam engines are employed on the premises. In this case, when the nuisance is observed, the police caution the proprietors, and, if not abated, evidence is forwarded to the local authorities, who may prosecute under the Sanitary Act of 1866.

Club-houses, which are very great offenders, do not come under any of the Acts, and it is of the greatest consequence that remedial action should speedily take place with respect to these buildings.

Then again, with regard to donkey engines on board vessels, no measures can at present be taken to stop the nuisance which they create when belching forth large volumes of dense black smoke.

The following extract is taken from Counsel's opinion in the case of the S.S. "Era," belonging to the General Steam Navigation Company. After some preliminary remarks, the Counsel goes on to say:—

"I have come to the conclusion that the case of a donkey engine on a vessel which is only used for the working of cranes to hoist cargo in or out of the vessel, is not within the Statute. A steam engine furnace used in the *working of this steam vessel* is clearly not within the Statute, as such vessel is an ocean-going steamer; and I think that a donkey engine is not within the Statute, because the engines and furnaces of vessels are dealt with under Section 2, which only relates to steam engines and furnaces used *in the working of the steam vessel*, and that the case does not come within Section 1, because, although the first part of that section would apply to this donkey engine, yet the person who is made liable to the penalty *is every person so offending being the owner or occupier of the premises*, &c. In this case the donkey engine was used on a vessel when floating

in the river, and the Steam Company, which was the offending person, was not *the owner or occupier of any premises* on which the donkey engine was used. The only way, therefore, of getting rid of the nuisance complained of arising from donkey engines on board ocean-going steamers is, at a convenient opportunity to have the Acts on the subject amended."

The Acts in force have frequently been rendered inoperative, as administrators of the law are, in many cases, large producers of smoke themselves, especially in manufacturing districts, and they either refuse to convict, or, when fines must be imposed, they reduce them to sums so much below the minimum prescribed by the Act that they become quite useless, and the nuisance continues as great as ever.

By the kindness of the Chief Constable of Bolton and the Medical Officer of Health information has been obtained with reference to the police prosecutions which have taken place in this town during the last ten years. Not more than five or six cases of prosecution for smoke nuisance have occurred during that time. The last was on 28th April of this year, when a conviction was obtained and a fine of five shillings and costs imposed.

The local regulations for the restriction of the smoke nuisance are appended in Supplement No. 1 to this paper.

Communications from several of the leading Provincial Authorities have been received with reference to the prevention of smoke, and are appended as Supplements at the end of this paper: Nos. 2, 3, 4, 5 and 6.

The Council of the National Smoke Abatement Institution some time ago drew the attention of the Home Secretary to the inefficient administration of the Smoke Abatement Acts, and showed that in many cases reported no proceedings are taken; that, when proceedings are instituted, the fines imposed are inadequate; that nothing is done to restrict or prevent the nuisance arising from river steamers; and that the Acts no longer cover the enlarged area of the metropolis. Unfortunately no action resulted from the course then taken; it is, however, to be hoped that legislation will by-and-by bring about an improved condition of affairs.

The Commissioner of Police, in his report about four years ago, drew attention to the great changes which had taken place in the construction of bakers' ovens, and which had resulted in a diminution in the number of prosecutions; but his report also showed that, notwithstanding the introduction of ovens heated by coke and gas, bakers were still the chief offenders.

The National Smoke Abatement Institution summarized the report issued by the Commissioner of Police for the Metropolis

for 1885. The number of prosecutions was 124; the convictions 120; the average fine being £2 5s. 11d. Sixty-six of the fines were under the minimum of forty shillings specified by the Acts.

In his report for 1886 the Chief Commissioner of Police of the Metropolis states that the number of prosecutions was 92, convictions 82, and the average fines £1 17s. 5d., and he says, further :—

"The smallness and irregularity of the fines inflicted are again very noticeable. The average fine for the year 1886, it will be observed, is lower by 18½ per cent. than the previous year, and the number of cases in which the fine inflicted was *below* the minimum prescribed by the Act was also lower, equalling nearly 54 per cent. of the total number. The fines inflicted for similar offences varied between the extremes of 1s. and £20. The furnaces used for generating steam and for baking bread have been again those chiefly complained of during the year. Attention has again been called to the fact that smoke from these sources might readily be prevented entirely, and that, while some steam users and bakers carry on their trade without causing any nuisance whatever, others allow their chimneys to emit more or less smoke almost continuously."

Considerable attention has been paid in recent years to improvements in industrial appliances for the prevention of smoke. Evidence laid by competent persons before the National Smoke Abatement Institution, and a series of careful tests conducted by that Institution, both prove that smoke can be entirely obviated in the furnaces of potteries, breweries and steam vessels (all great offenders in the metropolis), and that not only with benefit to the public, but with economy to the proprietors. This is effected mainly by the fires being supplied with fuel in small and continuous quantities, by means of movable firebars on to which the coal is fed automatically; and these advantages are gained even while still using bitumenous coal. Bakers' ovens can be made smokeless by the employment of coke, anthracite, or gas, the last being best in several ways; the reason that it is not more widely employed, being that the initial cost of gas is greater than the initial cost of solid fuel, even though the after economy is greater.

Mr. D. K. Clark, the testing engineer to the National Smoke Abatement Institution, has prepared a short memorandum, giving particulars of some apparatus examined and reported upon by the Institution during the last twelve months. This memorandum is embodied in Supplement No. 7, at the end of this paper.

With regard to domestic fire-places, the under-feeding system

is applicable to them as well as to furnaces, and will prevent smoke, even when bitumenous coal is burnt, requiring only an addition to the ordinary grate. The cost is inconsiderable, and in new houses grates and kitcheners on this system could be supplied at no greater expense than that of the existing arrangements. So many methods exist by which the abolition of smoke from domestic chimneys can be effected, either by structural alteration of a slight description or by change of fuel, that it is not necessary to advocate any one in particular. Very careful tests and experiments were made at the Smoke Abatement Exhibition of 1881, and between that time and the Health Exhibition of 1884, numerous improvements were made in domestic heating apparatus, and all information on the subject, with particulars regarding alterations in grates, the advantages of fire-tiles, and the employment of coke and anthracite as fuel, can be obtained by the public from the reports of those Exhibitions, or from the National Smoke Abatement Institution.

To illustrate what attention has been given to these subjects, and what improvements have been effected in the last ten years, it may be mentioned that during that time over 4,200 patents have been taken out for all kinds of apparatus: for condensing gases; for improving fireplaces, kitcheners, and stoves of every description; for improving furnace fire-bars, stokers, steam generators, town refuse consumers, and the methods for supplying air to the same; also for various systems of heating buildings. This gives an average of more than 420 inventions per annum during the last decade, all helping in some measure towards the result we have in view, and tending to prove that public opinion is in favour of the attempt to abolish smoke.

It may be objected that any change in the fuel of daily domestic use would tend to increase the price of anthracite and to diminish the industry in bitumenous coal; but this is not the case. There will probably always be persons who prefer this coal to other fuel, and it has been shown that it can be burnt without producing smoke. Its uses in other directions would suffer no diminution. Employed in the manufacture of gas (which involves also the production of coke), the value of its waste products alone creates several important industries. Sir William Siemens declared that the ideal of smokelessness was a perfectly gaseous fuel, and if the stimulus of legislation were applied in this direction, interest rather than compulsion would induce the gas companies to supply a cheaper kind of heating gas (as distinct from lighting gas), and the results to them in the combined profits to be made on heating gas, coke, and the products of distillation, would be enormously beneficial. Sooner

or later the advantages of gas as a cooking and heating agent must make themselves apparent to the public, and wherever large quantities of gas are used there can be no fear of injury to the coal trade.

The chief aims of the National Smoke Abatement Institution will have been gathered from the foregoing remarks, but it may not be amiss briefly to summarise them. Foremost, of course, as its name indicates, its aim is to promote the abatement of coal smoke, and it has enquired, with this end in view, into the state and practical working of the law regarding smoke; it has endeavoured to gather reliable information as to the effects of smoke upon public health and property; it has investigated the appliances at present available for the reduction of smoke and their comparative value, and it has encouraged improvements in domestic and industrial apparatus, and in the economical use of solid and gaseous fuel. It has carefully analysed the administration of the law in London for several years past, and repeatedly made representations to the Home Office showing wherein the operation of the law is inadequate and needing amendment. Although hitherto these representations have not succeeded in obtaining further legislation, or a greater amount of activity under the existing laws, yet the Institution keeps the matter before the mind of the public and the attention of the Government, and it is hoped that ere long these exertions may be rewarded.

The figures quoted with regard to the number of patents testify to the impetus given by the Institution, and by the Smoke Abatement Exhibition of 1881, to inventors in this line of work, and the encouragement offered towards bringing forward improvements of all kinds.

By reference to the Reports of the Institution the public can obtain detailed information of every description, regarding existing patterns of apparatus for domestic and industrial use. They can also furnish themselves with the results of elaborate tests conducted by the Institution as to the respective merits of various systems and different forms of apparatus. These results have already been widely circulated, and can be easily procured. Want of funds prevents these valuable tests from being still further extended, as it is desirable they should be, in view of the legislation which it is hoped will ere long be brought about in the matter of abolishing, or at least diminishing, the production of smoke in our large towns. An Institution whose aims and exertions are entirely in the public interest deserves some considerable measure of support and encouragement.

It can scarcely be necessary here to dilate upon the extreme unhealthiness of the black fogs which every winter afflict large

towns like London, Glasgow, and Manchester, and which are caused mainly by the vast quantities of smoke allowed to escape into the atmosphere. They differ entirely from the mists of nature, which may and do arise in marshy districts, and which are moist and white. No one who has once experienced a bad fog in town is likely to forget the dense, heavy, oppressive feeling of the air, and the unnatural darkness at midday that can almost be felt.

Housewives see the effect of these fogs in the thick and clammy deposit of "smuts" which is to be found, while they prevail, even in the innermost recesses of the dwelling.

Statistics inform us of the sudden deaths, among cabmen and others long exposed to the pernicious influence, which invariably occur during a real "London fog;" and medical papers have told how the respiratory organs of persons so dying have been found, on examination, to be blackened and choked by the amount of actual soot they have been forced to inhale.

Besides being unhealthy, these fogs are costly in the extreme. Setting aside the enormous waste of fuel existing wherever smoke is not properly consumed, it is a painfully evident fact that houses, statues, monuments, and the finest historic and public buildings decay and corrode rapidly in an atmosphere so highly charged with carbon and sulphur; and someone, curious in these matters, has calculated that the sum spent on gas by London, during one day of bad fog, over and above the usual daily expenditure, would be more than sufficient to pay for the alterations necessary to make every fireplace in the metropolis smokeless. The saving that would be effected in a thousand ways, should this happy consummation ever be reached, is beyond calculation. Houses, furniture, and decorations, clothing would all last longer, and the beauty, as well as durability, of our surroundings be materially increased. A smoky atmosphere is almost universally deleterious; upon inanimate objects, upon vegetation, upon human life and well being, its baneful effects may be seen everywhere and at any time.

London fogs may benefit the shareholders of gas companies, but they are good for no one else. The increase of mortality in a week of fog has equalled that in a week of a cholera season, running up the rate by an extra forty per thousand. The climate of London and other large towns becomes, especially in winter, less endurable; a state of things which cries aloud for remedial measures of a wholesale and sweeping description.

From force of circumstances to which it is unnecessary to allude, this paper has been prepared in a somewhat hasty manner, but by indicating the subdivisions of the subject, it is

hoped that special papers may hereafter be prepared; and it is further hoped that gentlemen present, familiar with one or other of the subjects named, will take the opportunity (if time permits) of expressing their opinions and practical experience.

Supplement No. 1.

Communications from the Medical Officer of Health, Bolton, Edward Sergeant, Esq., L.R.C.P.Lond., M.R.C.S.

We have not been very successful in the proceedings which we have taken before the magistrates in cases against owners or manufacturers, they being very loth at giving decisions against the manufacturers, especially if the latter have made the least pretence at doing something, either in constructing the furnace, or providing apparatus necessary for consuming the black smoke which may arise from the combustible burned; the magistrates holding that if the furnace is constructed in such manner as to consume, "as far as practicable," the smoke arising from such furnace, then the manufacturer has done all that is required of him. However, by taking frequent observations and continually watching the stokers, and letting them know that they are being watched, and giving them a copy of the results of observations, we are enabled to exercise a salutary check upon gross carelessness on the part of the major portion of firemen in the borough.

Notes on Smoke Abatement, by the Inspector for the Southern District, Borough of Bolton.

There are several appliances at work for the prevention of smoke, namely, Bennis' Patent Feeders; Proctor's, Hodgkinson's &c., appliances for self-feeding. I find in these cases, if left to themselves, that the smoke is somewhat regulated and successful in that respect; but the coal that has to be used, or is used, being small as a rule, does not get sufficiently burnt out, and comes from the chimney or shaft in coal dust or grit, and hence, though somewhat abating the smoke, creates a nuisance in the immediate neighbourhood.

There are other appliances, such as revolving bars, and either through the inferior coal used or mismanagement, the general complaint is that they are a great expense through getting burnt away so soon, and not supplying a sufficient quantity of steam.

The complaint from the large manufactories in the centre of the town is the want of boiler space, which they allege they cannot get in old established works; but I find great laxity on the part of firemen.

In some few places a small jet of steam is inserted under and over the fire at the front of the boiler and fireplace, to assist, and I consider with good effect, if there is careful firing.

Notes on Smoke Abatement, by the Inspector for the Northern District, Borough of Bolton.

Many of the large firms have provided various means of reducing the amount of dense smoke by mechanical stokers, hoppers, louvre doors, steam jets, and movable bars; these are often neglected by carelessness on the part of stokers or persons having charge of the boiler, by breaking up the fires with rakes and throwing on coal by hand, and not using the appliances provided by their employers. Any carelessness in this respect can be met by the Bolton Corporation Act, 1872, Section 97. Hand firing, if carefully managed by the fireman—"if not sufficient boiler room,"—is equal to many of the appliances supplied to boilers; the abatement of dense smoke is to a large extent in the hands of the fireman. Vertical boilers used by small tradesmen cause a great nuisance.

Bolton Corporation Act, 1872.

Consumption of Smoke by Engines, &c.

97. If any engine-worker, stoker, or other person having the care or management of any steam-engine, not being a locomotive engine used on the railway of any company incorporated by Act of Parliament, or of any furnace used for the purpose of any trade, business or operation other than those to which the provisions of the Nuisances Removal Act of England, 1855, are declared not to extend, at any time uses or manages any such steam-engine or furnace so that the smoke arising therefrom is not effectually consumed or burnt; so far as, having regard to the nature of the trade, business or operation carried on, may be practicable he shall, for every such offence be liable to a penalty not exceeding five shillings: provided that if it is proved before the Justices on the hearing of any information against any such engine-worker, stoker, or other person having the care or management of any such steam-engine or furnace, that he has carefully attended to the same and caused the smoke arising therefrom to be consumed or burnt so far as the construction of the steam-engine or furnace will allow, or as, having regard to the nature of such trade, business or operation may be practicable; or in case the defendant on the hearing of any information under this section proves to the Justices that the act complained of was committed within ten minutes from the time when the fire was first lighted in the furnace on the

day in question, then and in every such case the Justices may dismiss the information without proceeding to a conviction. Provided also, that one penalty shall be recoverable for any number of offences by the same person on the same day.

Supplement No. 2.

Communication from the Mayor of Manchester, F. J. Harwood, Esq.

In this city all proceedings are taken under the Public Health Act. A local Act, subsequently obtained, enables the Justices in their discretion to increase the penalty to £10 per day.

Three officers are engaged specially in connection with Smoke nuisances, and the number of chimneys under observation is about 1760.

Proceedings are taken against offenders where the black smoke emitted amounts to two minutes or over in a thirty minutes' observation.

Where black smoke is emitted for one minute and under two, the inspector makes a report of the case, and an intimation to this effect is forwarded by the superintendent to the offending firm.

During the year ending April 30th, 1887, the proceedings taken under the powers conferred upon the Corporation will be seen from the accompanying Tables:—

Statement of the Proceedings taken under the direction of the Smoke Nuisance Sub-Committee for securing the Abatement of Nuisances arising from Smoke.

Description of Works.	Observations taken.	Number of Firms served with Notices.	Mills Visited, and Owners cautioned.	Totals.	Number of Persons and Firms Summoned before the Sub-Committee.				
					Number Summoned.	Number Fined.	Number Excused, Dismissed, or Reprimanded.	Number referred to Magistrates.	Amount of Fines imposed. £ s. d.
Breweries	175	2	28	205	...	...	...	...	......
Corn Mills	132	4	30	166	...	...	...	...	......
Calender Works	820	10	90	920	...	...	...	...	......
Machinists	875	18	109	1002	5	3	...	2	4 0 0
Manufacturing Chemists	592	5	70	667	...	...	...	...	......
Print and Dye Works	720	6	115	841	5	4	...	1	4 0 0
Saw Mills	820	6	110	936	...	...	...	...	......
Silk and Cotton Mills	856	6	131	993	17	9	4	4	11 10 0
Smallware Manufacturers.	475	...	65	540	...	...	...	...	......
Miscellaneous	1173	37	247	1457	57	29	6	22	34 10 0
	6638	94	995	7727	84	45	10	29	54 0 0

Showing the Number of Cases in which Magistrates' Summonses were taken out, and the disposal of the same.

	Description of Offence.	No. of Summonses taken out.	No. of Persons Fined.	No. ordered to pay Costs only.	No of Orders Granted.	No. of Warrants Granted.	No. Excused, Dismissed, or Reprimanded.	No. of Summonses Withdrawn.	Amount of Fines imposed.
									£ s. d.
Smoke.	Allowing black smoke to be emitted from chimneys	24	...	...	23	...	...	1	....
	Neglecting to comply with Magistrates' orders to abate nuisance from black smoke ...	29	26	...	...	...	...	3	22 10 0

Supplement No. 3.

Communication from the Mayor of Liverpool, Sir James Poole.

In Liverpool smoke nuisances are for the most part dealt with under a local Act, and the same is in many instances preferable to the general statute, because fewer preliminaries are requisite before taking action. The following extract from the Report of the Medical Officer of Health for the years 1885 and 1886 shows the proceedings which are taken in this city for the prevention of the excessive emission of smoke.

Proceedings for Excessive Smoke—Year 1885.

Number of informations against Manufactories	486
" " " Steamers ...	220
" fined	581
" acquitted or withdrawn	125

Amount of Fines and Costs, £562 19s. 0d.

Year 1886.

Number of informations against Manufactories	352
" " " Steamers ...	200
" fined	545
" acquitted or withdrawn	7

Amount of Fines and Costs, £543 10s. 6d.

Liverpool Sanitary Amendment Act, 1854.

And whereas it is expedient to make further provision for the prevention of nuisances arising from the emission of smoke, be it enacted that the section of the said "Act ninth and tenth

of Victoria, chapter one hundred and twenty-seven, Liverpool Sanitary Act, 1846," number one hundred and twenty-six shall be and the same is hereby repealed; and in lieu thereof be it enacted that all furnaces employed or to be employed in the working of engines by steam, and all furnaces employed or to be employed in any mill, factory, forge, foundry, sugar refinery, pottery, distillery, chemical works, dyehouse, brewery, bakehouse, gasworks, waterworks, and other buildings used for the purpose of any trade or manufacture whatsoever within the said borough (whether a steam engine be used or employed therein or not), and all furnaces employed in working the engines of any steamboat plying on the River Mersey between the said borough and any place in the Counties Palatine of Chester and Lancaster, and of any steamtug or boat employed for the purpose of towing or hauling any ship in the said river, or plying for such employment, or of any steamboat plying for hire between the port of Liverpool and any place in the United Kingdom of Great Britain and Ireland, shall in all cases be constructed or altered so as to consume or burn the smoke arising from such furnace; and if any person shall use any such furnace which shall not be constructed so as to consume or burn its own smoke, or shall so negligently use any such furnace as that the smoke arising therefrom shall not be effectually consumed or burnt, or so that an unnecessary or excessive quantity of smoke shall be emitted, or shall carry on any trade or business which shall occasion any noxious or offensive effluvia, or otherwise annoy the neighbourhood or inhabitants without using the best practical means for preventing or counteracting such smoke or other annoyance, every person so offending, and the owner or occupier of the furnace from which such smoke is emitted, or of the place where such trade or business is carried on, and the owner of such steamboat, and the master or other person in command or charge of the same, shall forfeit and pay a sum of not more than five pounds for and in respect of every day during which or any part of which such furnace or annoyance shall be so used or continued, Provided always, that the words "consume or burn the smoke" shall not be held in all cases to mean "consume or burn all the smoke"; and the Justice or Justices before whom any person shall be summoned may remit the penalties enacted by this Act if he or they shall be of opinion that such person has so constructed or altered his furnace as to consume or burn as far as possible all the smoke arising from such furnace, and has carefully attended to the same, and consumed or burned as far as possible the smoke arising from such furnace. Provided also, that no information or other proceeding for the recovery of any

penalty under this enactment shall be laid or taken except by some officer of the Council duly authorised by the Health Committee in that behalf. Provided also, that the penalty for any such offence committed on the River Mersey may be recovered in the same manner as other penalties imposed by this Act are directed to be recovered, or before any two Justices acting for the Counties Palatine of Lancaster or Chester respectively.

That it shall be lawful for any Justice, upon complaint made to him by the Medical Officer of Health or the Inspector of Nuisances that any smoke, gas or vapour from any chimney is a nuisance to any of the inhabitants of the borough, to issue his summons calling upon the owner of such chimney to appear at a time and place named therein to answer such complaint; and if upon the hearing of such complaint the Justice shall think fit so to do, he may make an order requiring such owner to cause such chimney to be raised, or a funnel or pipe to be placed thereon for conveying away such smoke, gas or vapour, or such other means to be adopted as may seem fitting to such Justice for preventing or mitigating such nuisance, within such time as shall be specified in such order; and any such owner as aforesaid who shall neglect or refuse to obey such order, shall for such offence forfeit and pay a sum not exceeding five pounds, and a further sum not exceeding forty shillings for every day during which such neglect or refusal shall continue.

Whereas doubts have arisen respecting the application of section twenty-four of the Liverpool Sanitary Amendment Act 1854, which doubts it is expedient to remove; it is therefore hereby declared that the provisions of section twenty-four of the said Act of 1854 apply to all steamboats and to the furnaces of all steamboats plying for hire between the port of Liverpool and the Isle of Man.

Supplement No. 4.

Communication received from the Mayor, Sir H. Stephenson, and from the Medical Officer of Health, Sinclair White, Esq., M.D., Sheffield.

Under the provisions in the Public Health Act, 1875, a Smoke Inspector has been at work in this town for some years. His labours have resulted in an appreciable diminution in the amount of preventible smoke emitted; but the condition of the town in this respect is still very unsatisfactory.

There are, in addition to the chimneys carrying off smoke from engine fires, very many converting and other furnaces connected with the manufacture of steel and iron in the town.

These are, rightly or wrongly, held to be without the provisions enacted in Section 91 of the Public Health Act, 1875. The trade of Sheffield apart from these is of such a character as to favour the emission of black smoke. Unlike what is the case in the cotton and woollen producing towns, the amount of boiler power required in most manufactories varies largely from time to time, and a manufacturer must either erect boiler accommodation sufficient for the maximum at much additional cost, or be obliged to overfeed his fires from time to time. Speaking of boiler chimneys only, the factors engaged in producing black smoke are—

1. Too little boiler room.
2. Careless firing on the part of the engine tenter.
3. The use of inferior kinds of coal.

The first is the most important factor here. Mechanical appliances have met with indifferent success, and we rely much more on intelligent and regular firing.

The penalties to which offenders are liable are, in this town, practically a dead letter. Almost all the magistrates are in sympathy with the defaulters, and a compromise is the usual result of legal proceedings. This sympathy on the part of the intelligent public is the great drawback to improvement, and I see little hope of progress until it disappears.

Bearing in mind that the Smoke Inspector has to fight against wealthy and influential defaulters, I am of opinion he ought to be a man of education, possessing the knowledge of an expert, and occupying an independent position.

It is very desirable that some degree of uniformity should be arrived at as to what amount of black smoke constitutes a nuisance. We have here a general understanding that it should not exceed ten minutes per hour per chimney; but as the number of boiler fires going into any one chimney varies, it would be better to make the rule apply to fires rather than to chimneys. I am not without hope that the use of compressed air as a substitute for steam may do away with much smoke.

Supplement No. 5.

Communication from the Medical Officer of Health, Portsmouth, B. H. Mumley, Esq., M.D.

I regret to have to state that up to the present time the sections of the Public Health Act 1875 referring to smoke nuisances have practically been of no effect at Portsmouth.

Notices to abate the nuisances caused by smoke have been frequently served, but no action has followed, although nothing was ever done in consequence of the notices.

The difficulty was in getting evidence to show that the furnaces were not "constructed in such manner as to consume, as far as practicable," all smoke arising therefrom.

This difficulty is now, I am glad to say, overcome, as the borough engineer and myself have seen the mechanical stokers at work at the Lion Brewery in London, and proceedings against several brewers in the town are being commenced.

Supplement No. 6.

Communication from the Chief Constable, Dundee.

In this borough prosecutions are raised in the Police Court under the Smoke Nuisance Act 1857, by virtue of powers contained in the Dundee Police Act of 1882, at the instance of the Chief Constable and Procurator Fiscal. The duty of taking observations of smoke nuisance is performed by the sanitary staff, not less than two of whom are employed in each instance. They are stationed at different points, out of view of each other, for usually two hours; and if black smoke is seen to issue for ten or fifteen minutes consecutively, the case is reported with a view to proceedings being taken.

Supplement No. 7.

Memorandum of test trials for twelve months ending August 12*th*, 1887, *by D. K. Clark, M.Inst.C.E., Testing Engineer to the National Smoke Abatement Institution.*

The testing operations of the last twelve months supply clear evidence of (*a*) the direction in which the minds of inventors are engaged: (*b*) the attainment of complete and economical combustion of fuel, with the prevention of smoke in the furnaces of steam boilers. Invention is prosecuted under the double motive of the need for economising fuel, and the growing demand for more stringent legislation and magisterial action.

The objects are arrived at by the old-established principles on which perfect combustion is effected, namely, the maintenance of a high temperature, and the intimate mixture of the combustible gases with the air for combustion.

For giving practical effect to these principles, the air for combustion is in many designs heated before mixing with the gases, and is in some systems forced into mixture by means of a fan or other propeller. According to another system, the fresh fuel is charged underneath the body of the fuel on the grate, in a gradual, continuous manner, from which the combustible gases rise through the incandescent fuel in a highly heated state, and are burned with the air supplied through the grate.

The first in chronological order is Moerath's furnace. The fire-bars are hollow from end to end, and they are traversed by air which passes into them from the ashpit at the bridge-end, whence the air travels through the bars towards the front, being heated in its course, and is discharged through numerous openings in each side of each bar, passing upwards through the fuel, with the air direct from the ashpit. The flow of air into the bars is promoted by an "air-sucker" or guiding plate at the bridge.

In another system, that of Mr. J. E. Brown, an inverted cast-iron air-box, open at the lower part, is placed upon the fire-grate, at the back, against the bridge, and faced with firetile. From the front face of the box, the air which passes into the box through the fire-grate, is delivered into the furnace through a number of perforations, in order that the streams of air may meet and mingle with the burning gases before they pass over the bridge, and so complete the combustion.

The Thompson system of hollow fire-bar hot-air furnace, has been thoroughly tested, with results which demonstrate the effectiveness of a supply of heated air for the combustion of the gases, properly mixed. Mr. Thompson passes air from the front through a number of hollow fire-bars, in traversing which it is heated, and from which it is discharged at the back of the bridge, where it meets and mixes with the combustible gases from the furnace. The mixture is promoted by means of a second bridge behind the first, with an inverted bridge or baffler placed intermediately. A working economy of from 10 per cent. to 13 per cent. of fuel is effected, under favourable circumstances, by the adoption of Mr. Thompson's combination, in place of the ordinary furnace.

The Ashworth and Kneen system, recently submitted to test trials, likewise demonstrates the effectiveness and economy of a supply of heated air, with high temperatures and intimate mixture. A transverse partition is constructed in the flue behind the bridge, perforated with numerous zigzag passages, through which the draught is subdivided and is driven from side to side, and promptly and effectively mixed. Air heated in the flues is supplied under pressure, or as a forced current, and is delivered into and through the zigzag perforations, thoroughly mixing with and burning the combustible gases. The results of test trials show an economy of 30 per cent. of fuel, under the particular conditions of the trials with a special boiler. It remains to be determined what the practical economy will be in ordinary Lancashire boilers.

The Hopcraft system of revolving grate, with a central under-feed and a forced blast, is at present in course of trial by

the Institution. It is very effective as a smoke preventer, and it promises also to be economical in fuel. Welsh dust, which is difficult fuel, is successfully burned on this grate.

Economy of fuel, it should be kept in view, may be effected in two forms: by reducing the rate of consumption of the same fuel for the same duty, or by the substitution of a cheaper fuel, as the various coal slacks. There the mechanical stokers operate with good effect. With the Vicars' stoker, which has recently been tested by the Institution, a large degree of economy has been effected in the substitution of slack for Welsh coal, whereby the cost for fuel to evaporate 1,000 gallons of water was reduced from 10s. 7¼d. by the ordinary furnace, to 7s. 7½d. by the Stoker, showing 28 per cent. economy.

The recent advances made in the practice of coal burning in steam boilers, above indicated, according to the test trials made by the National Smoke Abatement Institution, are the more remarkable when contrasted with the results of professedly smoke-preventing furnaces tested in connection with the Smoke Abatement Exhibition in 1881-82. These were directed, for the most part, to the prevention of smoke, irrespective of economy, and the only systems in which the prevention of smoke was absolutely complete, Blocksage's and Barber's, depended upon a highly heated reverberatory furnace of fire-brick, enclosing the burning fuel, for completely burning the fuel and preventing smoke. But these were not economical of fuel. They evaporated a mean of 6·65 pounds of cold water per pound of Yorkshire slack; while, in the recent performances of Thompson's and Ashworth's furnaces, a mean of 9·64 pounds of cold water was evaporated per pound of Yorkshire slack. Taking the cost of the slack at 10*s*. per ton delivered, the contrast stands as follows:

	1881-82	1886–87
Coal consumed per 1000 galls. of water evaporated.........	13 cwt. 48 lbs.	9 cwt. 29 lbs.
Cost of fuel per 1000 galls........	6s. 8d.	4s. 7d.

Here is an apparent economy of 31 per cent. in 1886-87 as against 1881-82, combined with complete combustion.

The result of the year's testing has been to show that further improvement has taken place, both in the furnaces designed to substitute mechanical stoking for hand-stoking, and in those wherein ordinary hand-firing is employed.

[*For discussion on this paper see page* 335.]

On "Smoke Abatement," by ORLAND D. ORVIS, Chicago, U.S.A.

MR. PRESIDENT, MEMBERS, AND GENTLEMEN,

One of the greatest blessings which nature can confer upon mankind is good health. Every thing which can affect this priceless boon is of the most vital importance. How necessary then that we look carefully to the purity of the air we breathe, to the great supporter of life, *oxygen*, which we constantly inhale into our lungs. Air is a more indispensable agent than water or food. We cannot exist many moments without air. Water can be purified by boiling, by filtering, and by chemicals. But it would be practically impossible to effect a thorough filtration of the air before we inhale it.

The average composition of atmospheric air, according to Regnault, Bunsen, Dalton, and others, is in volumes:—

Oxygen	20·96
Nitrogen	79·00
Carbonic acid	0·04
	100·00

The purity of the air is more or less affected by other substances, such as the products of combustion of coal, vapour of water, ozone, ammonia, organic and inorganic dust, and the decomposition of organic matter.

One of the chief reasons why the atmosphere of cities is not so pure and healthful as it is found to be in the country, is because the enormous volume of coal-gas and smoke emitted from thousands of chimneys in large cities pollutes the air with noxious vapours destructive alike to animal and vegetable life.

From the vast forests of chimneys in all the great manufacturing towns in England, there arises a dense exhalation of inky blackness, which envelopes these cities in a pall of gloom from Monday morning until Saturday night. It is only on the Sabbath that we are permitted to catch a glimpse of clear blue sky, and breathe the pure air, so essential to health and comfort.

The sooty vapour finds its way to our food and drink, it is

inhaled into the lungs, impairs the health, stains and discolours the walls of public and private buildings, soils the face and clothing, penetrates houses, smears carpets and furniture, almost destroys oil paintings, soils books and engravings and whatever precious objects of art or utility we try to preserve. Indeed it is difficult to say in what particular we are not harmed by the all-persuasive soot and smoke. However much opinions may have differed, there is little doubt now that the cause of the London fogs can be traced to the smoke. The infinitesimal particles of water-vapour floating in the atmosphere, become coated with the volatile products of combustion—the sooty particles of carbon which float in the hydrogen,—and these countless myriads of molecules or atoms, impervious to the sun's rays, envelope the great Metropolis in impenetrable gloom.

The highest medical authorities attest the injurious effects on the respiratory organs, and on the body generally, from living in a smoke-laden atmosphere. The fatal consequences of the fogs to which London and other great towns are periodically subjected are shown by a marked increase, on these occasions in the Registrar General's returns of mortality.

The prevention of smoke is the great want of the age.

In this era of invention and progress, when the fertile brain of the scientist and the inventive genius of the skilled mechanic are achieving such marvels of invention, it is almost a wonder that the great problem of abating the "smoke nuisance" of large cities should have remained so long unsolved. The secret art of burning bituminous coal without allowing a large part of its carbon to escape in a cloud of smoke, seems to have baffled the wits of inventors during the past 200 years. The alchemists, in 1685, tried various devices for the purpose of consuming the smoke in their furnaces. In 1785, Watt patented an apparatus for consuming smoke. His process consisted in feeding the coal in a hopper, and forcing the gas and smoke to pass through a body of hot coal.

As far back as 1306, the smoke of burning sea coal was considered to be so injurious to public health, that King Edward I. issued an order forbidding its use. It is alleged that one man who disregarded the King's order, was tried, convicted and executed for burning sea coal in London.

Much might be said relative to the history of the various fuels used by civilized man during the past few hundreds of years. It is a curious history, the progress from wood to coke, and from coke to coal. Wood and coke are now little used for steaming purposes in this country, and King Coal is the present ruling monarch on the throne of fuels. Anthracite is the most condensed form of mineral coal, and the richest in carbon. All

coals, including naphtha, petroleum, asphaltum, &c., are but representatives of the change from vegetable to mineral matters.

Anthracite is the condensed coke of bituminous coal. American anthracite possesses from 85 to 92 per cent. carbon, and $2\frac{1}{2}$ to $4\frac{1}{2}$ hydrogen. South Wales and Russian anthracite have been found to possess as high as 95 per cent. carbon. Bituminous coal possesses about 80 per cent. carbon and 5 hydrogen, and from 10 to 50 per cent. bitumen, from which smoke is produced.

Concerning the origin of coal, its connection with the vegetable kingdom is too distinctly traced to admit of any reasonable doubt that this fuel once formed parts of growing plants, requiring in its geological transformation many thousands of years. The coal, then, which we see burnt in our furnaces to-day liberates the heat and light of the sun's rays which have been stored in the coal through countless ages.

The total amount of coal consumed annually in the United States now exceeds 100,000,000 tons. The annual consumption of coal in Great Britain is now not far from 150,000,000 tons. The entire annual product of the world is estimated at 300,000,000 tons.

Should the coal supply ever become exhausted, Nature, in her bounteous wisdom, has provided us with a still better fuel, viz., *Petroleum*, which is now quite extensively used as fuel in the United States and in Russia. Liquid fuel, however, would prove to be rather an expensive luxury in England at the present low price of coal.

Some of our ablest scientists maintain that the area of the subterranean seas of petroleum is even greater than that of the coal beds of the world, and that petroleum distillation in Nature's vast laboratory is still going on as rapidly as ever.

It is only by the light of modern science that we are enabled to explain the meaning of the heat given off in the act of chemical combustion. Fifty years ago we possessed no knowledge of chemical dynamics.

Combustion consists in the oxygen of the air uniting (forming a chemical union) with the constituents of the combustible substance.

The chemical combination of atmospheric oxygen with the carbon of coal is always accompanied by the production of more or less heat, but it is only when the action is so rapid as to evolve intense heat, accompanied by light that the process is called burning or combustion. A few substances burn at ordinary temperature, such as phosphorous, which glows when exposed to the air. While the absolute amount of heat evolved during the combustion of any burning body is the same, yet the

sensible heat may vary according to the rapidity of the process. Thus, when phosphorous is exposed to the air at ordinary temperature it very slowly combines with oxygen, and gives out little heat at any one moment, but it is diffused over a great length of time, while if the phosphorous is set fire to in the air, it burns vividly, and gives out much heat and light for a short time, and still further, if the burning phosphorous be placed in pure oxygen, it enters into most vivid combustion, and evolves a most intense heat and brilliant light for a still shorter time. The same remarks apply to the coal consumed in a furnace. So long as the furnace-door is left open, and there is little draft of air through the fuel, a moderate amount of heat is evolved, which may last for several hours; but when the door is shut, and much air is drawn through the coal, the latter is more quickly burned, and more heat is evolved during a shorter period of time than before, but in the long-run there is the same amount of heat evolved.

A fresh charge of coal thrown upon a fire absorbs heat which liberates the gas from which flame is produced. This gas is composed of hydrogen and carbon—carburetted hydrogen. Coal gas will ignite only as it combines with the oxygen of air. The hydrogen then separates itself from its fellow-constituent, carbon, and unites with atmospheric oxygen producing steam. Carbonic acid is the result of perfect combustion, and is a compound of one atom of carbon with two atoms of oxygen. Carbonic oxide is composed of one atom of carbon and one atom of oxygen, only half of the required amount of oxygen to produce perfect combustion. The air in passing through the grate bars, gives out its oxygen to the incandescent carbon, producing intense heat, in the formation of carbonic acid. This acid passing upwards through the body of unconsumed coal, absorbs an additional portion of carbon and becomes carbonic oxide. This carbonic oxide, of which smoke is the visible part, inflames at a lower temperature than ordinary coal gas, and is often ignited at the top of the chimney, on meeting the air, as seen in the chimneys of blast furnaces, and steam vessels.

It requires, chemically, the oxygen of 152 cubic ft. of air to consume one pound of coal. The gas requires 45 and the coke 107 cubic ft. A furnace charged with fresh coal, generates a large volume of gas (about four cubic ft. to each pound of coal), requiring an equivalent quantity of pure air for its combustion. Now, by reason of the mass of fresh fuel thrown in, the passage of air through it is necessarily the most restricted. Thus the smallest quantity of air will be enabled to gain admission simultaneously with the greatest demand for it, and the largest generation of gas simultaneously with the most restricted means

of enabling the air to obtain access. And hence the absolute necessity of providing some other means of introducing air to the unconsumed gas, *above the fire.*

Coal in process of combustion yields volatile hydrocarbons equal to about one-third of its weight, which have to be burned in the open space above the fuel, or, for want of air, escape unconsumed. It is plainly necessary, therefore, that the required amount of oxygen to complete combustion should be supplied *above* the surface of the burning fuel.

Some writers of note on combustion, and many scientific men, still hold that smoke, after it is once formed, cannot be burned. I am frequently told that the term "smoke consumer" is a misnomer. C. Wye Williams, the great English apostle of combustion, has benefitted the world by writing a book. All ambitious writers of books do not benefit mankind. Mr. Williams says:—"When smoke is once produced in a furnace or flue, it is as impossible to burn it, or convert it into heating purposes, as it would be to convert the smoke issuing from the flame of a candle to the purposes of heat or light." Mr. Williams undoubtedly wrote in advance of his time, and yet modern science has placed him far behind the advanced column of progress, and rendered some of his theories obsolete.

The visible part of smoke is composed of floating particles of detached carbon, and the invisible part is rich in coal gas and carbonic oxide, all of which is, of course, easily ignited and burned.

An interesting experiment in proof of the correctness of the above assertion may be made with a common tallow candle by extinguishing the flame, and then, with a lighted wax match or taper, the smoke can be *ignited* and *burned* several inches away from the wick, the blaze at once relighting the candle; thus conclusively proving that smoke is combustible matter, and can be burned after it is formed.

A steam boiler furnace in action is analogous to animal life, inasmuch as both require carbonaceous food and atmospheric air to support life, and each emit a product of carbonic acid gas.

The books say that the ordinary steam-boiler converts 8 to 10 per cent. of the energy of the fuel into steam, and the *very best* boilers convert 12 to 14 per cent. But the human stomach of a healthy young man realises from 60 to 67 per cent. of the food's energy, and converts it into heat and work. Steam of say three or four atmospheric pressure contains about 1,000 to to 1,100 units of heat, three-quarters of it "latent," so called. In passing this steam through the cylinders in work, the temperature is only reduced 200 to 300 degrees, according to

the expansion. Hence, speaking roundly, three-quarters of the energy, or steam-heat, escapes up the exhaust-pipe without having done any work, so that we only realise 3 to $3\frac{1}{2}$ per cent. of the energy or power of the coal in the steam-engine in the form of work, but in the stomach of a man about two-thirds of the power of the carbon consumed as food can be converted into effort or work.

Thus are we reminded of the superiority of nature over the inventions of man. This has been truly called the age of invention. One of the grandest roles in the great drama of human progress has been filled by invention. Invention and civilisation have come up out of the ages hand-in-hand. Fancy for a single moment what this world would be if deprived of the inventions of the Stephensons, the Morses, the Fultons, and others of their kind. But it should be borne in mind that the solution of the great problem of abating the smoke-nuisance has many difficulties to overcome. It is not sufficient simply to consume the smoke. There are several other important points required. The perfect smoke-consumer must possess the merit of combining all of the following cardinal virtues: (1) Burn smoke; (2) Save fuel; (3) Make steam; (4) Be durable; (5) Not injure the boiler. If the apparatus fails in a single point, although it possesses all the others, it is condemned.

Some of the methods which have been tried for the purpose of preventing smoke are:—

1. A small steam-pipe is run from the dome down the front of the furnace, and a blast of steam is injected into the furnace over the fire. This plan entails a loss of fuel, for the reason that the extra heat produced will not generate an equivalent amount of steam used in creating the blast.

2. The addition of atmospheric air with steam by the *induction* principle is no improvement on the process.

3. Directing this oxyhydrogen current under the grate bars is a mistaken theory, unsupported by either chemistry or good practice.

4. The various bridge-wall contrivances for admitting air, or air and steam, only partially prevent smoke, and are liable to injure the boiler-sheet by the volcanic action produced in concentrating the heat. Any principle is defective which allows imperfect combustion to take place at all and then tries to correct it afterwards.

5. The idea of a steam-jet in the chimney to increase the draft sufficiently to consume smoke on stationary boilers, is too unscientific and wasteful to merit further comment.

6. Brick arches are good enough in their way, but they are not very effective in consuming smoke, unless aided by a

combination with some contrivance for assisting the draught, such as the steam-jet, or under-blast.

7. Efforts have been made to precipitate the soot and smoke by a wheel, or a shower of water falling through a perforated diaphragm placed in the chimney. In this process of smoke-washing, or smoke-condensing, the principle is wrong, the evil should be prevented in the furnace, and then no "shower-bath" will be required.

There has been nothing new patented in steam-jets for upwards of a hundred years, according to the sixty-page report of M. Armangeau of Paris, excepting the principle of the "air vacuum." This principle consists in arranging a steam-jet within a closed globe in such a manner as to make the velocity of the air, just as it comes in contact with the steam, as nearly as possible equal to that of the steam. It was a knowledge of principles which led to this conclusion, and the reason is the same as that for causing the velocity of corn when it falls upon a carrying-band to be equal to that of the band. The corn would have been left behind if it had not this velocity, and so also the air would be left behind by the carrying steam, and would be whirled into eddies with a loss of force, if it had not sufficient velocity at the point of contact with the steam. All steam-jet appliances on the old "induction" plan use a much greater quantity of steam than is required by the "vacuum" principle to force a given quantity of air into a furnace. The inventor has been awarded eleven gold and silver medals, and several diplomas and decorations for this discovery.

It is well known that oxygen, or atmospheric air in rapid form, produces combustion, and in slow form oxidation. Heat is evolved by the clashing of atoms. To consume smoke in a furnace, therefore, it becomes necessary to supply the air in rapid form. The steam-jet is the most simple, practical, economical, and effective means known for accomplishing this result.

The oxyhydrogen currents should be injected at the front end of the furnace on a horizontal plane, in converging lines, a little above the burning fuel, in order that they may travel with the natural draft of the furnace, and where the temperature is at least 830° F.

The most economical results will be obtained by using a mixture of superheated steam, hot air, and carbonic oxide.

I am often asked how these oxyhydrogen currents can produce extra heat in a furnace without burning more coal. The principle of the jeweller's lamp and the blow pipe, fully answers this question.

The *rationale* of this principle is to supply the furnace with

just enough oxygen of the air, hydrogen of steam, and carbonic oxide, to unite with the volatile hydrocarbons and other rising products of combustion given off in the distillation of coal, and form a mixture of carburetted and olefiant gas, which readily ignites at a temperature of about 800° F., and burns with a bright clear flame, creating perfect combustion, and no smoke. These remarkable results are produced from the chemical affinities of carbon, oxygen, and hydrogen respectively.

The principle of the air vacuum has been amply demonstrated on the boilers of the Paris Water Works, and is now largely in use both in France and America. In London, also, several chimneys have been rendered smokeless by the adoption of this simple remedy. Some of the enterprising citizens of Bolton, not to be behind the times, have already tested the efficacy of this improved system of fuel economy and smoke prevention on their own boilers, and we may soon expect to see this beautiful city free from smoke, her worthy citizens enjoying the luxury of pure fresh air at home, and thereby enabling the ladies to cultivate beautiful flowers and healthful rosy cheeks at the same time. Then will the fame of this fair city become a household word in the land for having set an example so worthy the emulation of all smoke-laden towns in England.

[*This discussion applies to the three preceding papers by* Mr. HERBERT FLETCHER, Mr. D. J. RUSSELL DUNCAN, *and* Mr. ORLAND D. ORVIS.]

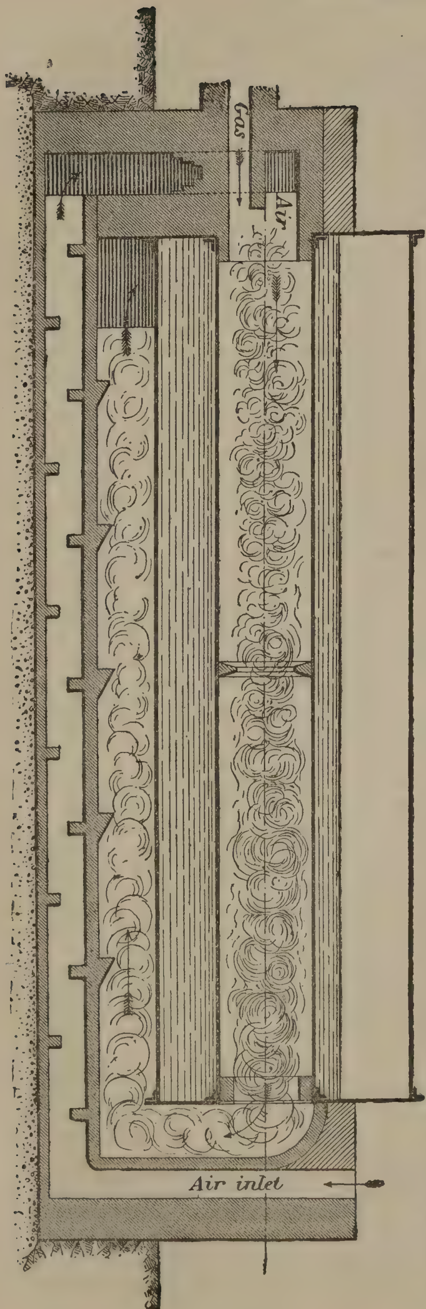
Mr. R. K. FREEMAN, F.R.I.B.A. (Bolton), who took the chair in the absence of the President, remarked that they had had the question brought before them in all its bearings. It was one of the utmost importance to them in Bolton, because although they did not like, in consequence of depression in trade, to see chimneys not smoking, they would be glad if they could be in full work, but without turning out the volumes of smoke they did at present.

Mr. W. R. E. COLES (London), called on by the Chairman to open the discussion, said that as the subject was a large one, and papers were only read at such a late hour as to allow but barely ten minutes for the whole discussion, he would not attempt to consider them in detail. He would only say he did not think the author of the first paper was right in speaking so lightly of domestic smoke, the quantity of which was undoubtedly very considerable in the aggregate. The action of the legislature against smoke had been directed, as the meeting knew, to industrial processes only. This was obviously not

quite fair, and anything which was not fair did not generally work out to a successful issue. Where the law was thus defective the administration of it was likely to be defective also. There was a natural objection to enforce the law fully against one class of offenders when another class was permitted to go free. He thought the question of domestic smoke was to be considered from that point of view as well as from the standpoint of its quantity. Mr. Duncan's reference to Lord Stratheden and Campbell's Bill, which he said had been for the fourth time before the House of Lords, was well worthy of notice. The chief aim of that Bill was to deal with smoke from all its sources, domestic chimneys as well as industrial. And, in regard to the former, it proposed to do what seemed to be a wise thing, viz., to discriminate between new buildings to be erected and the already existing ones. In regard to new buildings it proposed that the regulations should be so framed as to bring the heating arrangements of the houses of the future under some supervision and control, analogous to that already exercised under various building Acts and bye-laws, with the object of securing the efficiency of other branches of house construction and equipment; while in regard to existing domestic chimneys, it proposed that the local authority should be invested with power to make such bye-laws as were considered judicious, and it seemed to him that that was a good provision because the local authorities were duly conversant with what was going on; they knew what could and what could not be done in their own houses, and moreover they were not likely to act in advance of general public opinion. In speaking of new buildings it was very important to remember what was the actual rate of building. He had looked into that matter three or four years ago, and found that in London the rate of building amounted to *three new houses an hour* from the 1st January to 31st December. Since that calculation was made, however, the rate of increase had been somewhat reduced, but he found it still amounted to one and a half new houses per hour for every hour of the year. With regard to the question of patents taken out for so-called smoke preventers, he thought Mr. Duncan's remarks were worthy of consideration, for a great deal of smoke was produced by reliance upon patents, which might be avoided if only the existing arrangements were properly used.

Mr. John Head, F.G.S.* (London), said that had his occupations permitted of his doing so, he would have prepared a paper upon Gas-Fired Boilers to be read at the present meeting—in the form of an address; however, he would lay some facts before the meeting which would help those interested in the question of the best method of firing boilers, to consider the subject from a different point of view to that which had been so ably brought before them by the authors of the papers whose practice was limited, however, to boilers fired with solid fuel. Members, or at any rate, some of them, had certainly heard of the Siemens Regenerative Gas Furnace. The Siemens Furnace had been employed in the manufacture of iron, steel, glass, &c., for more than a quarter of a century. In the first instance, and indeed, until quite recently, the flame was utilized in the Regenerative Gas Furnace in

* Communication received by the Secretary in continuation of the discussion on the papers.



the same manner as in furnaces fired with solid fuel, that is, it was brought into contact, as much as possible, with the materials under treatment. For the last two or three years Mr. Frederick Siemens, who, conjointly with his brother, the late Sir William Siemens, invented the Siemens Furnace, had worked upon different lines, and, indeed, had made a new departure from the beaten track, whence had resulted great improvement in the efficiency, economy, and durability of the Siemens Furnace. Mr. Siemens, when considering the action of gaseous flame in a furnace heated by contact, came to the conclusion that the flame was misapplied; he found that combustion was disturbed, and the flame was partly wasted by being brought into contact with any solid substance whatever, and that this was particularly the case with boilers, the plates of which, being in contact with water, must necessarily and constantly be at a temperature considerably below that of the flame. Mr. Siemens inferred, from consideration given to the subject, that a gaseous flame, in order to be utilized to the best advantage, should burn freely in an enclosed space without contact with the materials under treatment or surrounding objects, in other words, that it should be placed under conditions analogous to those which apply to gas burners. If we consider a gas flame used for artificial lighting, say an Argand or a flat flame burner, we shall at once realize how undesirable it would be to introduce therein any solid substance; the result would be loss of effect, which would become apparent by diminution in the light and heat obtained, coupled with the production of smoke. Expressed in this manner it becomes evident that contact of flame with solid substances is detrimental to combustion, and where heating by radiation has been adopted, the result of practice in high temperature

furnaces, such as used for the production of steel on the open hearth, for heating iron and steel, for the manufacture of glass and other purposes, has been a saving of from 30 to 40 per cent. in weight of fuel, improvement in the quality of the product, and diminished wear and tear of furnaces. With these encouraging results before him, Mr. Siemens considered the application of his new method of heating to the firing of boilers. This application is shown in the accompanying diagram, which, however, does not exactly represent a gas-fired boiler as constructed, being only intended to show the means adopted for preventing contact of flame with the plates in the flame flue. The gas producer, which is not shown, may be located in any convenient place near to the boiler to which it has to supply gas, and is of the Siemens usual well-known construction. Gas coming from the gas producer to the boiler passes through a regulating valve, and thence onwards to the combustion flue of the boiler, where it meets with a current of heated air, and entering into combustion therewith, the flame circulates first through the combustion flue, as shown, afterwards around the boiler at the sides, and finally underneath on its way to the chimney. The boiler is set in brickwork in much the same manner as for firing with solid fuel, the chief difference consisting in the provision of a double series of channels underneath, through some of which, as indicated by arrows, the products of combustion pass away to the chimney, while the inflowing air to the boiler passes through adjoining channels. By this means the products of combustion leaving the boiler are completely deprived of most of their sensible heat, the action being so perfect that at large works where these improved gas-fired boilers are used exclusively, the temperature in the main chimney-flue, at a short distance from the boilers, has been found to be much below the point of boiling water. As shown in the diagram, inside the combustion flue of the boiler are placed fire-clay rings, the object of which is to prevent contact of the flame with the plates of the boiler. A ring at each end of the combustion flue will suffice in short boilers, but where the length of flame flue exceeds, say, ten or twelve feet, as is almost always the case with boilers in this country, additional rings are provided at intervals. The flame flue should be clear from end to end as cross tubes would interfere with proper combustion, and it is preferred to have boilers, such as Cornish boilers, with only one large flame flue, although at some works boilers with two flame flues are used. The character and quality of the flame is subject to complete control by means of the gas regulating damper already referred to, the air regulating dampers, and the chimney damper also provided. By means of these dampers the temperature of the flame may be increased or diminished at will, or, in other words, the production of steam may be augmented or reduced at pleasure, and in either case without the production of smoke. In the papers which have been read, it was said that it was possible to avoid the production of smoke in boilers fired with solid fuel, provided that they are not pushed for the production of steam, which implies that the fires shall be kept thin and supplied with an excess of air, as otherwise smoke cannot be avoided. But in the case of boilers fired with gas and heated by radiation, no smoke need be made under any conditions of working, that is—whether a large or small quantity of steam be required at any time; in fact, the presence of smoke would reduce the temperature of the flame and cause a diminution in the production of steam, so that the man in charge of such boilers will find it convenient, and to his own interest, to avoid the production of smoke. Where a range of boilers is fired by gas, it is preferable to place them under a foreman who understands how to regulate the production of steam by regulating the supply of combustible gases to the boilers, and who can keep the men attending to the gas producers up to their work. Under such conditions boilers at work give regularly an evaporative power of from 9 to 10 lbs. of water per lb. of coal burnt in the gas producers. These results compare favourably with the best solid fuel-fired boilers; but better results having been obtained under certain circumstances in later applications, it is confidently expected that an evaporative power of from 11 to 12 lbs. of water per lb. of coal will

be obtained as a constant result. Where small fuel is available it can be used in the gas producers for the production of the gas required for firing boilers, and the saving thus effected, added to that in weight of fuel, will in many cases produce an economy of from 40 to 50 per cent. in the firing of boilers upon the present practice with solid fuel; this result will be obtained with less attention or hard work in firing, and will be attended with greater durability of boilers, and last though not least, with total absence of smoke.

Colonel WINDER (Bolton), drew attention to a paragraph in Mr. Duncan's paper which said, "The Acts in force have frequently been rendered inoperative, as administrators of the law are in many cases large producers of smoke themselves." He contended that there was no unanimity as to the kind of machinery or appliance that ought to be used for the successful consumption of smoke, and yet the magistrates were to be called upon to fine, to the heaviest extent, any gentlemen who would not submit to use the contrivance of every person who came forward and said he had the true remedy with regard to the consumption of smoke. He had sat in that Court many years, and had always found when the defendant appealed to the witnesses what was the article the witness wished him to use, he had never yet been able to authoritatively say, "I recommend this as the only article that ought to be used for the consumption of smoke." Nevertheless, Inspectors of Nuisances and Corporations must not lose heart with regard to this matter, nor be slack in enforcing the Act of Parliament, but they must keep close up to the requirements of the times, and see that if there were a machine or an appliance that could be adapted to this purpose they should require the public to immediately put it into use. He could think of nothing better than that the Government itself should use its greatest exertions to find out the most appropriate article, and see that it was duly provided for the public.

Mr. FRED. SCOTT (Manchester) said the last speaker had aptly illustrated the fruitlessness of much of the effort to abate this nuisance. If people like magistrates would not take the trouble to read the literature on the subject, and take such other means as were provided by organisations and individuals of ascertaining what is practicable in the way of smoke prevention, it was almost hopeless to induce town councillors to do so. The magistrates ought to inquire if the persons brought before them for offences against the law relating to smoke had in use such appliances as were known to be effective in preventing smoke. The Manchester Society, organised to remedy this nuisance, had done the best it could during the last ten years to secure its abatement. They were often charged, however, with trying to do things which would injure trade, but they sought to do nothing of the kind; their efforts were to a large extent fruitless, because, as had been pointed out in many cases, the administrators of the law were the greatest offenders. They had gone to the Local Government Board and the Local Authorities, and had done everything possible, yet the nuisance was still allowed to prevail

very extensively. He could not help thinking that perhaps they were on the wrong tack, and that what was wanted was "stronger municipal life." They must send men into councils who would take a broad view of the question; that by compelling manufacturers and other smoke-producers to adopt effective methods of smoke-prevention, they caused no hardship in the long run to the individual, whilst they conferred a great boon upon the community.

Mr. George S. Howatson* (London) pointed out that the most efficient system of smoke-preventing machinery in the market could be had at about the same cost as any mechanical stoker. Mr. Fletcher remarks that "many mechanical stokers are not smoke preventers at all," and in making this statement Mr. Fletcher has, in my opinion, struck the key-note to the solution of the whole question under discussion, because many steam users, mill managers, and engineers have got the idea that any appliance to which the name "mechanical stoker" has been given must necessarily be a smoke-preventer. This idea is altogether erroneous. It will generally be admitted that a man under any circumstances cannot fire a steam boiler with small bituminous coal or slack day after day without making smoke. Not only will smoke escape when each shovelful of slack is scattered over the fire, but it will also escape during the necessary operation of "stirring up" and of "clinkering" the fire. In exactly the same way many appliances to which the name "mechanical stoker" is given, produce smoke continuously, and dense black smoke during the necessary operation of "levelling" the fire. These "mechanical stokers" are of the "throwing-on" type, and although they frequently succeed in throwing-on and scattering the small coal better than a man does, they generally cause much of the dust fuel to be carried by the draught right over the fire, through the flues, and out at the chimney-top in a partially-consumed state. In London where a special Smoke Abatement Act is enforced in the interests of the community at large, steam-boiler owners find it practically impossible to use these "throwing-on" stokers (whether man or machine) and small cheap bituminous fuel without subjecting themselves continually to police interference and Scotland Yard prosecution. The other system of firing steam-boilers referred to by Mr. Fletcher, and adopted by him at his collieries, is on the principle advocated by James Watt about a century ago, and it has been adopted by many of the principal steam-users in London, proving that it is a complete and practical smoke-preventer and a most effectual and economical system of firing steam boilers, kilns, &c., with the smallest and cheapest bituminous fuels. At the Smoke Abatement Exhibition of 1881–2 Messrs. T. & T. Vicars, of Liverpool, Earlestown, and London, exhibited a mechanical smoke-preventing appliance, which received the highest award; since then, this smoke-preventing stoker and furnace on the Watt principle has been adopted by Her Majesty's Government at the Royal Mint, and many of the principal firms in the City of London and throughout the country have now adopted it, enabling them to use a small cheap bituminous fuel without making smoke, smuts, or creating any nuisance whatever. Steam is easily raised and kept up at an even pressure without manipulating the fires in any way by hand.

Mr. Nicholson declared that Mr. Fletcher was good enough to hit upon one of the principal sources of trouble in the matter. There appeared to be no real desire in any place to get rid of smoke because it was thought to be expensive; many were heartily sick of so many appliances, some of which were found out to be per-

* Communication received by the Secretary in continuation of the discussion on the papers.

fectly useless when tried, though he believed there was an honest disposition in favour of getting rid of the smoke if they could. The right way he thought was for the Association in conjunction with the Smoke Abatement Societies of London and elsewhere, to take steps and find out four, five, or six of the best means to get rid of smoke, and take upon themselves to recommend those they found most suitable. Without something of this kind very little good would be done. In concluding, the speaker observed that it must be very disheartening to gentlemen who had to deal with this subject and to bring people up for making smoke, to see the miserable sums which people were fined: real penalties and not nominal ones should be imposed.

Mr. G. Darley (Leeds) said there were a number of energetic men in Lancashire and Yorkshire with sufficient means to form themselves into a sort of council and test the best known appliances side by side on the boilers at the Manchester exhibition; this experiment would be far better than taking a single man's word. In Leeds they had every known make of mechanical stokers, and although they came with great faith many of them got into disgrace. He knew for a fact that there was a firm in their town that adopted mechanical stokers to eleven boilers, their consumption being about sixty-five tons per working day; and they were saving £1,500 a year for the expenditure of £650; fuel was reduced in quality at the rate of two shillings per ton. The saving he referred to was very good, but it was only one in a multitude of cases. The firm he alluded to consumed their smoke, but not so well as Mr. Fletcher did: he must give that gentleman credit for his system because he had seen nothing to equal it. The London waterworks boilers had Vickars' stokers adapted to them, and they did their work admirably. He should like the course recommended to be adopted, viz., that Bolton, Manchester, Leeds, and other northern towns, should combine and form one council to work the matter fairly and test the machines on their merits, be they Vickars, Bennis, Proctor, Hutchinson, or any other.

Mr. Leach (Eccles) said it appeared to him to be the proper duty of the Congress to investigate this question, as by so acting it would be doing a most important work for all manufacturing districts in the kingdom. He suggested that a test might take place in Bolton, and would also like to move a resolution that a committee of the Congress be appointed to make an investigation in London with the view of recommending such appliances as were found to be most suitable.

Mr. Freeman (Bolton) said he did not know whether this latter proposal was within the scope of the meeting.

Mr. Lee said the test should be made by practical men. They had no wish to disparage scientific men, but it was a fact that practical

men occasionally looked into practical matters in a way which perhaps men who were not accustomed to them every day did not.

Mr. W. Wilkinson (Bury) thought it would be much better if the appliances could be sent to Bolton and practically tested there in the centre of the smoke-producing locality; this would give more satisfaction than referring the thing to London.

Mr. F. Scott (Manchester) thought the idea of initiating an enquiry into the means of smoke prevention a good one, and hoped the Council of the Institute would take it up. He had much pleasure in seconding the motion.

Mr. Leach (Eccles) having been granted permission, proposed the following resolution: "That the Council of the Sanitary Institute be requested to institute an examination into the best methods of consuming smoke and to issue the result of their enquiries." The resolution was seconded and adopted.

Mr. H. Fletcher (Bolton) in replying, said the difficulty most frequently alleged to exist was that of an insufficient number of boilers. He thought no one who erected more machinery than his boilers would drive should be allowed to create a public nuisance, on the plea that compliance with the Public Health Act might possibly affect the profits of his trade. With regard to domestic smoke, he said he did not under-rate it; his paper only referred to manufacturing smoke. He believed it presented a great difficulty. The use of coke he understood was the only remedy for it consistent with retaining the open fire. Saturday afternoons and Sundays shewed what might be attained in improving the atmosphere by the suppression of the tall chimney smoke. Vegetation could exist in such smoke as was then seen. Referring to the remark of the Clerk to the Borough Magistrates, that they could not convict while experts differed as to the best appliances, he said, he understood it was their duty to fine unless it could be proved that the nuisance was not preventible having regard to the nature of the manufacture. All that was necessary to prove was the practicability of obeying the law. If steam could be raised without smoke, in one place, it could in another. The best question to ask a smoke preventive machine maker was, have you one in operation within the area embraced by the Metropolitan Smoke Act? If he had, they might assume the apparatus to be a pretty good one. Mr. Darley made an excellent suggestion in submitting that the Galloways boilers at the Manchester Exhibition should be used for so good a national purpose as ascertaining the merits of smoke preventing contrivances. The firing of those ten boilers resulted in the emission of a cloud of smoke that was a disgrace to an engineering country, let alone an exhibition of the best that Manchester and its neighbourhood could do. An opportunity had been lost that might never recur.

Mr. D. J. Russell Duncan (London) said one gentleman appeared to be under the impression that a magistrate should act as a consulting engineer, and advise the people who came before him. With regard to magistrates being offenders, he could mention one place in Scotland where magistrates were very heavy offenders indeed, and where there was no law for smoke abatement.

Mr. Freeman (Bolton) remarked that they could not say the question had been left where they found it, because an important recommendation had been forwarded to the Council of the Institute. It was a matter of regret that they had been unavoidably hurried, but he trusted the subject would have greater attention devoted to it in the future than hitherto. Mr. Fletcher, he might remark, had shown publicly what he had been able to do himself, and there was no doubt many other people would strive with him to remedy as far as possible what was one of the great curses of a manufacturing district. In conclusion, he hoped that that Conference, and the views expressed, would impress themselves very forcibly upon the public generally, and result in some good being done in Bolton.

On "Sanitary Sewage and Water Supply," by Edwin Chadwick, C.B.

I beg to submit some statements of experiences at variance with statements that have been made to the Congress on sewage irrigation. In the first place, no perception is evinced in them of the great distinction for sanitation of sewage which is undecomposed, and the sewage of the common conditions of putrefaction; of sewage which feeds fish, and of sewage which kills them; of sewage which, for agricultural purposes, is wasted by putrefaction, and of sewage which is unwasted by decomposition, which has generally about a third more of power for agricultural production. Nor do they recognise the power of the production of fresh sewage as a means of removing the popular objections to sewage farms near towns with sewage that is putrefied, the results of bad drainage and of internal stagnation; nor that with sewage which is fresh there is a reduction of the evils that arise from the common high culture with solid manure; as that of the market garden—the culture of marachere—by top dressings with the solid dressings with decomposing manures. The great principle laid down by De Condalle, the greatest known vegetable physiologist of the last century, verified in

practical examples, and cited in our instructions, "that the future of agriculture would be in the distribution of food and water together at the same time," is neglected. The proofs are overlooked of the verifications that have appeared in various examples—that whilst the yield of ordinary agriculture is as one, that of the extraordinary agriculture, the marachere, or market garden culture, is as three and a half—the yield from the liquefied culture is as five and more. Thus at Croydon, on the fields irrigated with fresh manure, five cows are reared where only one was formerly. An adjacent well-conducted example gives a sixfold yield from the fresh liquefied manure culture.

It is extensively put about against the direct application of fresh sewerage to agricultural production that, as a rule, the utilisation of human excreta, either *per se* or in the form of sewage, is generally attended with very considerable loss, and that only in a very few cases has it been attended with a profit. Such statements denote very imperfect examinations, which would display the extraneous causes of loss from the application of the cheapest means of working. However, Professor Corfield, in his work on the utilisation of sewage, gives a table of the application of the sewage of sixteen towns, and states that, judging from the results of one year, after the repayment of capital for outlay in works connected with the sewage farms, in eleven farms out of the sixteen there is a profit to the ratepayers. That, as respects London, there should be any profit under the combined system adopted by the Vestries, would be a matter of surprise, when it is considered that of the water distributed full three-fifths is distributed in pernicious waste in the production of excrement-sodden subsoils; and as to the water-closets, two and three gallons are used where little more than half a gallon would suffice, altogether producing an extent of dilution that must render it worth little more than a fourth of its value under the separate system. At the time of our examination of the water supply of the Metropolis in 1850, it was found that by the service of large Cornish engines of ninety horse-power, upwards of seventy thousand gallons was raised one hundred feet high for a working expense of one shilling. With the improvement recently made in steam-engines, it will be possible to raise nearly double that amount for one shilling. And why could not sewage be distributed at a like charge by the like power? As to the profits of sewage farming, tenants are not in the habit of considering that they are obliged to disclose them; indeed, they generally be-little them for the apprehended increase of their landlords' unearned increments. In the case of the tenant for the farm of the sewage for Alder-

shot, he gave it up, and it was inferred at once and declared that he gave it up because it would not pay; he gave it up on account of a severe illness and a succession to a large estate which required his immediate attention. He thought himself at liberty to show me from his accounts that, under extreme difficulties, from an inferior soil, and inferior and partly putrid sewage, he had made a profit of ten thousand pounds in eleven years, from about ninety acres, under these extraordinary difficulties. As to towns, take the instance of Croydon. Under the mistaken notion that the sewage can only be distributed by gravitation on lands in immediate contiguity to the town, a rent of upwards of ten pounds an acre was exacted for it, for land of which the ordinary rent was twenty-three shillings per acre. Then there was the wastefulness of ignorance of the municipality. Town councillors—utterly unacquainted with the new management and the increased skill it required—gave the management as Dr. A. Carpenter may recount, to a man of inferior capacity for management of an ordinary farm at the lowest wages; and yet with such conditions the farm yielded a little over the working expenses.

In almost every case, storm and subsoil water has been conveyed with the sewage, diluting, and thus reducing its manurial value, and increasing in volume at the time when the rain-sodden land was least adapted for its reception.

As an example of the exactions with which sewage farms are frequently charged, it may be mentioned that one city desired to rent some land which rented at ten shillings an acre, but the Right Hon. Landlord exacted four pounds per acre for his supposed monopoly of a site where it could only be applied by gravitation. The average value of land was from twenty to thirty years' purchase, but 150 years' purchase have been charged by noble lords upon towns for the application of their sewage. These exactions of unearned increments—I have had the agreement of noble lords—might be well satisfied by a right of pre-emption for public purposes, at an average of two years of the previous rent. In addition to such factitious charges are the excessive legal expenses for obtaining the sanction of Parliament for local Acts for towns; expenses that would suffice for the construction of a large proportion of the really requisite works. Moreover, there are frequently large constructions of unnecessary and expensive works by civil engineers, who are unacquainted with the economies of construction required in agriculture. In addition to these there are the expenses of unnecessary works of disinfection, and construction of unnecessary reservoirs for stagnant detentions for "raw sewage" that would suffice for farm steadings.

In place of downward distribution through the soil for disinfection, and the discharge of the bulk of the sewage in waste—destructive of the fish of the river or the sea—there is properly the discharge of the sewage fresh, for inoffensive application on the surface of the land. Unscientific common agriculture gives usually only one top-dressing of manure a year (of manure in the solid form), in which it wastes in disintegration by the putrefactive insanitary decomposition, which makes the contiguity of market gardens at times specially offensive and injurious. The skilled horticulturist, the proper plant-feeder for sewage farming, gives two, three, or four dressings a week to the vegetation on the drained and prepared soil, as it may want to speed the growth of wood or leaf, or to develop superior fruit.

Where pipe distribution is used, as it may be the best for rapidity of distribution, over unequal surfaces, at from a halfpenny to a penny per ton, advice was particularly given for the large works at Rugby, as well as for farms, that plots of the land should be tested by distributions by hand or water-carts to determine its particular receptivity, and the extent of the pipeage that would suffice for it. By the common neglect of that advice, the extent and the expense of pipeage has been largely increased, often to double the extent of what would have sufficed, as well as double the area of land that was needed; and hence the like mistakes have occurred in the works for liquefied manure farms. And these defaults of want of skill and of competent science have been overlooked in the common allegation that sewage farms and "liquefied manure farms do not pay." Nevertheless, it may be observed that although liquefied manure culture is a delicate culture, requiring the skill of the horticulturist, and is beyond the capacity of the common agriculturist, the yield of the common liquefied manure farms has been from ten to twenty bushels per acre beyond the yield of common agriculture, with a real increase of profit. One detriment to the liquefied culture has frequently been that the highly superior quality of the produce in grass has brought from game preserves, and from extraordinarily long distances, rabbits and hares which the farmers were not allowed to kill in their own defence.

Competent superior administration would by competent central administration, and by that alone, protect the population of towns by the enforcement of the old common law responsibilities for nonfeasance, for misfeasance, and malfeasance which still subsist, although they may have fallen into desuetude and press for revival.

Insanitary chemistry only proposes to treat "raw" sewage—

"crude" sewage—that is to say putrefactive sewage, with expensive and really useless disinfectants. Such chemistry speaks of utilising the putrid sewage of one hundred of the population on one acre of soil; sanitary science will now utilise the sewage of more than a hundred and fifty of the population for a greatly superior agricultural production on the same area.

The people of Paris have had no experience of any condition of sewage except that of putridity, and hence, believing in none, and seeing but little except the irrigations with partially putrid, though very successful, irrigations at Gennevilliers, are much opposed to sewage irrigations immediately close to Paris. Even Dr. Jules Brocard, of the Academy of Medicine, who, in an able article in the *Revue des Deux Mondes*, advocates the removal of the anarchy of local administration in France, and the adoption of the principle I proposed a long time ago, of a centralisation of a scientific administration for the people, in place of the centralisation they now have—even he gives no exposition of the large organic difference and the economy of sewage which is undecomposed and fresh. He has probably seen nothing of it, and knows no more of it than the people of Paris. They, and indeed some members of the Institute, have noses vitiated by the putrefaction, and the common conditions of the filth diseases. They are, therefore, I am led to expect, as yet unprepared to accept the axiom that the condition and the capacity of superior legislation and of local executive administration may be popularly tested sanitarily by the nose. Members of the Political Economy Club of Paris, including the writer for the *Journal des Debats*, have to be informed, and to be impressed with the great maxim enunciated by H. I. Highness the Crown Prince, the President of the recent Congress at Vienna, that every subject has a money value, and how largely that value is depreciated, and strength and happiness is reduced by the existing removable conditions of insanitation.

It will, I expect, be found that at the present time double the expense is being incurred for disinfecting the sewage made putrid by the combined system in our Metropolis, by throwing away the productive power for the sustenance of some two hundred cows, than would suffice for the direct application of fresh sewage to the land, and maintaining conditions, despite of the report of Lord Bramwell's commission having declared them to be "a disgrace to the Metropolis and to civilisation."

When stripped of factitious adjuncts, water carriage, instead of being the dearest, will be found to be the cheapest and one of the most economical methods of agricultural production. It is to be observed that all the factitious charges which have been

specified—the results of bad legislation and maladministration by incompetent hands, from which, for the public protection, it ought to be removed—are usually passed over without any examination, and are presented as the natural and necessary results of sewage farming that unavoidably render it more expensive than the prevalent ancient methods of agriculture. It is proper to note these great fallacies, and submit them for close examination, as was done by the Sanitary Congress for Berlin, which led to the adoption of the principle of the circulation of fresh sewage against that of stagnation and putridity; that is to say, of carrying a constant supply of pure spring water at high pressure into every house and into every flat of every house, and by self-cleansing house-drains and apparatus, conveying immediately away, and before decomposition could commence, the fouled water into self-cleansing sewers, and by those self-cleansing sewers conveying it at once fresh and unwasted on to decimed and prepared land. This is what is being done in that city, though somewhat less perfectly, I believe, than might be, and very wastefully and slowly, as I consider, for the relief of the population. The principles of sanitation are now, I consider, so far established that, on the plans of sanitary engineers, they might warrant a capitalist in contracting for the attainment of large results in the improvement in the health and strength and the great pecuniary economy of the charges of premature mortality, and the excessive sickness of the lower classes of the population.

On "The Sanitary Condition of Water Supplies," by EDWIN CHADWICK, C.B.

MY earliest examinations led me to prefer, beyond all, supplies of soft water to hard water for the superior solubility of the soft water, for the saving of soap, of tea, and its superior potability over hard water. I do not remember that any question of supplies for the larger cities or towns in Lancashire came before our first General Board of Health, unless it was at Lancaster and one or two places where supplies on a correct sanitary principle were carried out by our Inspector, Sir Robert Rawlinson. At the time I heard of some infusions of peat in the common supplies of that period from the surface washings of lands I did not regard those infusions as very serious objections, as the peat was represented as containing tannin, an astringent of incon-

siderable account. But later experiences have shown that the infusions of peat are seriously injurious—that in flood periods they produce serious dyspepsia; that at Glasgow, Aberdeen, Dublin and Manchester, during the floods of heavy rains, when the supplies are discoloured, they cannot be drank with safety for two or three months; and they are attended with the evil of creating a resource to alcoholic stimulants. It has been the practice of engineers who are not sanitarians to bring the water to the doors of private houses in bulk, and to leave the internal distributary apparatus to be provided by plumbers, who generally prefer and provide lead pipes for its superior convenience and for the profit of the expense. It fell to my own son, who is a sanitary engineer, to carry out a new system for working at Odessa, and he completed it with the capillories for the houses entirely with iron pipes. At all times soft water attacks and decomposes lead, and I am informed that at Manchester there has been a serious amount of lead poisoning, and so it will probably be at the other cities. The protection is, iron piping—armed by coating on Dr. Angus Smith's or other processes. All this goes to augment the importance of soft spring collections, and where only chalk or hard spring sources are available, to having the whole supply softened by the improvements on Clark's process, as is now done effectually at Canterbury Bushy, and an increasing number of other places. At these places water of eighteen degrees of hardness is reduced to not more than two or three degrees of hardness, or about the ordinary hardness of soft water supplies. In the lake supplies of towns such as Manchester, threads of water may be seen in dry months running down the hill sides, which a sanitary engineer should examine, when they will be found to be mostly the outcome of springs, which should be carefully collected at the outcome, and carried to a reservoir, whence the water may be distributed in its purity. As to the method of collection, I was led, from observation of the outcomes from land drainage, to propose that method of collection for the supply of the Metropolis from the uncultivated grounds of the Surrey sands. The method has been resorted to by the Grand Junction Company, at the instance of Mr. Best, a sanitary engineer, attended with a result never, I believe, known before of a collection of water in such a condition of purity as to need no first filtration from reservoirs, nor any second or domestic filtrations, and to be in every way superior to them. The first practice of engineers who are not sanitarians in the chief water supplies of our Metropolis displays the effects of ignorance of sanitary science in the omission of a due regard to the diverse sanitary effects of differences in the qualities of the *aëration* of the supplies. At

the sources of the Thames supply, as at Pangbourne, the water is clear and brilliant, and stones may be seen clearly at the bottom, some twenty or thirty feet deep. The water drank there is highly aërated and refreshing. Some way farther on the water was taken up for storage in open reservoirs. There algæ were generated, and died with extraordinary rapidity, leaving pernicious infusions of decaying animal matter. Taken from thence for urban distribution, under the intermittent system of supply, it was delivered into cisterns, whence it stagnated, was further de-aërated, and it absorbed town air. In the lower districts, in courts and alleys, in tubs over cesspools, it absorbs the cesspool air. Taken up by women into their overcrowded bedrooms, and kept stagnant in open vessels, it absorbed the pernicious foul air of the overcrowding. Surgeons who have performed operations there, and who have applied such water as there was there to wash their hands, usually find their hands smell disagreebly until they are rewashed. Generally, if there be any outbreak of malaria pervading a district, it is rapidly absorbed by exposed stagnant water, as in wells, and people are led to believe they have been poisoned. In these several conditions, the person drinking the water at its source may be said to be drinking pure and invigorating air. Drinking it after stagnation in the uncovered reservoir, he would be drinking it de-aërated, and with much vegetable and animal infusoria and some decaying animal matter. Drinking it after stagnation in a house cistern, he would be drinking inferior town air. Drinking it after stagnation in an open vat, in a court or alley, in the immediate vicinity of foul cesspools, he would be drinking cesspool air; or, after standing in the overcrowded single room, he would be drinking the foul and dangerous air of the apartment. The effective preventive of such insanitary conditions is direct delivery at constant high pressure of water from a pure source, which preserves the pure aëratum, and without any intervening cisternage or stagnant detention whatever. On the occurrence of the visitation of the cholera in 1848-49, we directed an examination of the conditions of courts and alleys, and then water supplies, when the supposition that the people did drink water—a supposition very extensively entertained at present—was treated with ridicule: they only drank beer. And this will be found to be very generally the conditions of distribution at present from the old insanitary works. The families of the poorer classes now also drink tea, or coffee, or water after boiling for cooking, which prevents, or considerably reduces, their dangers. The wealthy are protected by their Apollinaris, or other aërated waters, as their beverages. An instance is

stated of the dread of water supplies by the poor, that a mother who was taken with her children on an outing, was extremely anxious that they should not drink water, and only beer. The intake of water for the supply of the prisoners in the Millbank Prison was from the River Thames, sewer polluted, opposite. A change to a supply obtained from a spring source at Trafalgar Square, presented an overwhelming example of sanitary improvement in the health of the prisoners. In another paper submitted to the Congress I have presented other examples of errors prevalent in the treatment of water carriage for irrigation and sewage farming. The application of these great sanitary improvements for our Metropolis is at present impeded by the disunity of the private trading companies, which distribute their supplies with an injurious waste of not less than three out of five of the quantity consumed. I deem the application of the most advanced sanitary science to be requisite on every point of the question of water supplies, for the protection of the health and economy of the population, and against the wastefulness of ignorance, and of insanitary engineering.

SECTION III.

CHEMISTRY, METEOROLOGY, AND GEOLOGY.

ADDRESS

By August Dupré, Ph.D., F.C.S., F.R.S.

PRESIDENT OF THE SECTION.

In this jubilee year there is a very general tendency in those occupying a position such as I now occupy before you, to review the progress made during the fifty years just elapsed in the various sciences to which our attention will be directed. The accomplishment of such a task would, however, involve too great a claim on your time and patience, even if it were in my power to do justice to the theme.

On the general subject I will therefore content myself in stating that, as far at any rate as modern times are concerned, sanitary science is, practically, a product of the last fifty years, and surely no other advance in art, science, or industry made during Her Majesty's reign has contributed more to the welfare and happiness of the nation.

In the following remarks I shall restrict myself to two questions, regarding which I may claim some special acquaintance, namely, the questions of water analysis and the treatment of sewage. Both subjects, I am afraid, have been frequently treated of at former sanitary congresses, and we are promised several papers on the subject to-day; but as they are, perhaps, the two most important questions on which the chemist can assist the sanitarian, I hope you will bear with me for a short time while I endeavour to bring some of the more salient features before you. In doing this I shall have to point out defects in our present methods, and shall venture to point out directions in which, in my opinion, further advance should be sought; for I believe that the function of a Congress such as this is not only the taking note of any progress made, but also to stimulate research and facilitate further progress. And now let us, in the first instance, turn to the question of water. Here, strictly speaking, all the chemist has to do is to find out the various sub-

stances contained in a given sample of water, and leave it to the medical man and sanitary engineer to draw their own conclusions, and apply their own remedies. Such a division of labour would be, ideally, the most perfect; and it is, I think, frequently carried out, as between the sanitary engineer and the chemist. The provinces of the medical man and the chemist are not however, as a rule, kept so strictly separate; nor are they, perhaps, so readily separable. The chemist thus frequently usurps the functions of the medical man, and the medical man those of the chemist; the result is not always such as would be most desirable or beneficial. As a chemist I trust I may be pardoned in saying that, in my opinion, the fault is more often on the side of the medical man than on that of the chemist. Questions, strictly medical, that arise in relation to our ordinary domestic water supply are, after all, but few; whereas, on the other hand, water analysis becomes every year more and more complicated and specialized, and requires a greater and greater amount of skill and knowledge for its successful prosecution, so much so that the time seems almost to have come for the setting up of a special class of chemists devoting themselves entirely to the examination of water.

Thirty or so years ago water analysis, I speak of it of course merely in relation to its sanitary aspect, was, comparatively speaking, a very simple matter. It consisted mainly, and I well remember the time, in the estimation of the total dry solid residue left by the water on evaporation, of the loss suffered by this residue on ignition, a loss usually put down as organic matter, and perhaps, a more or less rough examination of the nature of the mineral matters present. Gradually however, as the influence on health, exerted by the quality of the water consumed, became more and more recognised, the necessity for a more complete knowledge of the matters present in a water required for domestic use became increasingly pressing. New methods of analysis were devised and perfected until at the present day we are in possession of analytical processes which, so far as the detection and estimation of dead matters are concerned, leave but little to be desired. Without going minutely through these various processes, I may be permitted to glance shortly at some of them, mainly however in regard to the various constituents which it was, or is, desired to estimate.

The various substances found in a water, as far as they are of interest to the sanitarian, may be roughly divided into three classes. *Firstly*, mineral matters derived solely from the soil or rock through which the water has percolated; *secondly*, mineral matters derived either directly from organic matter, such as

nitric acid and ammonia, or which, as being frequently found associated with certain kinds of organic matters, indicate by their presence the probable or possible pollution of the water by these organic matters, such as chlorine and phosphoric acid, always associated with the urine of men and animals; and *thirdly*, organic matters. Living organisms I leave out of consideration for the present.

In regard to matters falling into the first class, little or nothing need be said here, for unless they are present in excessive proportions they need not, as a rule, trouble the sanitarian. I of course exclude from this general statement all distinctly poisonous mineral matters occasionally found in potable waters, and also, for the present, such mineral matters as may exert an injurious action on the materials with which the water, in the course of domestic use, is brought into contact.

The next class, namely, those mineral matters directly derived from organic matters, or those the presence of which indicates the probable presence of organic matters, offers however far greater difficulties; not so much in regard to the analytical processes to be employed as in the interpretation to be put on the results obtained. This latter point, though by no means the only, is by far the main difficulty we have to deal with, and very serious differences regarding it exist among analysts. The matters falling into this category are mainly *nitric acid*, *ammonia*, *chlorine* and *phosphoric* acid, and, in a minor degree, sulphuric acid and the alkali metals, sodium and potassium.

Nitric acid.—This was early recognized as a most important feature in a sanitary analysis of water, and there is probably no single point connected with water analysis regarding which so many analytical processes have been elaborated, or which has raised more discussion in relation to the significance of the indications furnished. As regards the processes used for its quantitative estimation I need not trouble you here, they may be found fully described in many books and papers, and it must suffice to say that the analyst has a choice of a number which fulfil all requirements as regards accuracy and ease of execution. The choice of any particular process is greatly a question of training and convenience. As far as I myself am concerned, the process I chiefly employ is the indigo process, which, when carefully conducted, is accurate enough for all practical purposes. When however we come to the interpretation of the analytical data obtained, difficulties begin to crowd upon us. In the first place very few, if any, unpolluted waters are found free from nitric acid, and the mere presence of this acid cannot be taken as of any significance, and quantity has to be taken into account. The question thus presents itself, how does this nitric acid get

into the water? Now, in the first place, rain-water, which is the source of all our wells, spring or river water, always contains traces of nitric acid, and this nitric acid is probably produced mainly by purely physical agencies. The nitric acid from this source is, however, as far as we know at present, the only nitric acid thus produced, and its amount is, fortunately, extremely small, not more than a few hundredths of a grain per gallon on an average. The presence of this nitric acid clearly cannot be taken as indicating organic pollution. The main quantity of the nitric acid, however, is derived, there can I think be no doubt, from nitrogenous organic matters, chiefly of animal origin, which have been decomposed or destroyed by the vital action of certain micro-organisms. It would thus appear that whenever we find more than a mere trace of nitric acid in a water, we should be justified in concluding that the water under consideration had, at some previous stage of its history, been polluted by nitrogenised organic matters, mainly of animal origin, or, as in the case of water, these matters are, practically, mainly derived from sewage or surface drainage, that the water had been polluted by sewage or drainage from manured land or some similar source.

It was this consideration, I suppose, which led Prof. Frankland to use the expression, "previous sewage contamination," for which he has been so severely criticised by many.

Now in great measure I agree with Prof. Frankland in the notion this term was intended to express, although in its practical application it requires some modification and caution. This modification is required because we are acquainted with certain waters which contain appreciable quantities of nitric acid in excess of that derivable from rain-water, and which, nevertheless, from their position, depth, &c., cannot possibly have been subjected to any recent pollution by sewage or drainage from manured land, &c., and, therefore, as applied to such waters, the term is somewhat, not to say entirely, misleading. Not but that I believe that even in these cases the nitric acid is derived from nitrogenised animal matter by the intervention of micro-organisms; but this animal matter is not of recent origin, and may have been deposited contemporaneously with the chalk itself; it certainly is not derived from any recent sewage.

We are thus reduced to this position: the presence of nitric acid by itself, even when in appreciable quantity, cannot be taken as indicating sewage pollution (when I speak of sewage pollution I do not mean merely the liquid flowing in our sewers, but any organic matters derived from a similar source). What then is the amount of this acid, which, when found, must be

taken as proving such pollution? I shall try to answer the question, as far as I can, later on.

Ammonia.—There is such a concensus of opinion regarding ammonia that I will pass it over, and merely indicate an exception to the general rule which I know sometimes misleads analysts.

In some cases waters contain considerable proportions of ammonia derived from nitric acid, probably due to the reduction of the latter by micro-organisms, sometimes by the metal pipes conveying the water. In such cases, the presence of ammonia therefore does not indicate more than the nitric acid would have done; this is the case, for example, with some of the London chalk water.

Chlorine.—This is one of the most important of the purely mineral constituents to take into consideration, in judging the quality of a water; chlorine, as before stated, being a constant constituent of urine, and one which, unlike some other mineral matters, when once it has found its way into the water, remains there and can be traced with certainty. In our endeavours, however, to draw conclusions, the same difficulties confront us as we found in the case of nitric acid. Chlorine is present in waters, its amount varies greatly even in unpolluted waters, according to the character of the soils or geological formations from which the water is derived, or even according to its geographical positions. Thus water from wells or springs in the neighbourhood of the sea, or of tidal rivers, even though considerably above high water, but within the influence of spray carried by winds, frequently shows an amount of chlorine greatly in excess of what it would be if removed from these influences.

Phosphoric acid.—This, like chlorine, is a characteristic constituent of urine, and, like the substances just considered, is also found in every natural water, but, unlike these, it is, according to my experience, rarely or never found in any notable quantity in a pure unpolluted water. The presence therefore of phosphoric acid in anything beyond minute traces, is in my opinion, perhaps the strongest evidence we can obtain, from mineral matters alone, that the water under consideration is polluted by sewage. In the long series of analyses which I made some years ago in conjunction with Dr. Cory, for the Medical Department of the Local Government Board, I could not unfrequently pick out the polluted samples by the fact of their containing a greater proportion of phosphoric acid than the unpolluted water, even when all other analytical methods failed to bring out any clear distinction. But although the presence of phosphoric acid in any notable quantity may be

taken as one of the strongest proofs of pollution, its absence must not be taken as proving the absence of pollution, for there are many natural causes at work tending to the removal of phosphoric acid.

The Alkali Metals.—In relation to these I will merely state that whereas sodium is the greatly predominating alkali in the urine of men, the urine of horses and cattle contains a considerable proportion of potassium, and hence a careful estimation of these two alkali metals in a polluted water may sometimes enable us to find out the particular source of its pollution. In some cases this may be of importance from a sanitary point of view.

The presence, or absence, of the various mineral matters so far considered is, however, of interest mainly as throwing light on the previous history of the water. In themselves they are not injurious, and undoubtedly a water may be perfectly wholesome in spite of its containing considerable quantities of these various matters. So much so is this the case that, as is well known, one of our foremost water analysts, in judging of the suitability of a water for drinking, practically ignores the presence of most of them, notably that of nitric acid. This is bad enough in the hands of a master, but in the hands of his followers it leads to serious mistakes. For, although these animal matters throw light mainly on the past, they also enable us, to a great extent, to read the future. A water containing these matters in certain proportions must, at some previous period of its flow, have been contaminated by animal matters, or what comes to the same thing, must have passed through soil thus contaminated. In its passage through soil or rock the organic matters are removed or changed into mineral matters, some of which remain in the water and testify to the prior presence of the organic matter. The mineral matters with which the organic matter was associated also remain in greater or less proportion in the water. Now it is well known that this destruction of the organic matters depends upon a variety of circumstances, such as the amount of pollution, temperature, aëration of the soil, &c., &c. These conditions vary during the seasons of the year, and also from year to year, and hence a water which at one time contains these mineral matters only may, at another time, contain the organic matters from which these were derived, or with which they were associated. These mineral matters therefore indicate the possibility, in some cases the absolute certainty, that the water in which they are found will, at some other period, be charged with organic matter. It is this consideration that gives importance to these mineral matters in water analysis.

It is, however, the proportions of actual organic matter present in judging of the fitness or otherwise of a sample of water which, for domestic use, has been, and still is, our chief guide. Various processes have been devised to enable the analyst to form some approximate estimate of the amount of organic matter present in a water, but no process as yet known enables him to determine its absolute quantity. The old process, namely, of heating the dry residue to a red heat and finding the loss it sustained thereby, has now, I suppose, been universally discarded as useless for the purpose. Nevertheless, for all those at least who do not employ the organic carbon and nitrogen process, the simple ignition of the dry residue often yields valuable results. A pure water residue is white and does not change colour on heating. A residue from a water containing organic matter is usually more or less yellow or brown; it darkens or blackens on heating, but becomes white on continued application of heat, the carbon gradually burning off. Carbon derived from vegetable sources generally burns off readily, whereas the carbon derived from animal sources usually burns off with difficulty. For myself I never omit this simple process.

The next process in point of time, and which is still in use, is what is known as the permanganate process, the object of the process being the estimation of the amount of oxygen which the organic matter present is capable of abstracting from a solution of permanganate; and from this forming some sort of estimate as to the amount or nature of the organic matter present. Many chemists have worked at this process, but the modification which in my opinion gives the best results consists in acting on the water with the permanganate and acid, in a stoppered bottle and at a given temperature. The advantages gained by this are: 1st, all influence which the atmosphere of the laboratory may have on the permanganate solution is excluded, and no correction for it is necessary; 2nd, the presence of even considerable proportions of chlorides does not prevent the application of this test, even sea water may be tested;* and 3rd, uniformity of temperature insures uniformity of results—and strictly comparative results. A modification of this process employed by some, namely, boiling the acidulated water in a flask with permanganate solution for ten minutes, is, as a rule, quite inadmissible,

* The hydrochloric acid liberated from the chlorides by the sulphuric acid decomposes permanganate, and chlorine is produced. When the process is carried on in an open vessel much of this chlorine escapes into the air, and is lost; if however a closed bottle is employed the chlorine is retained, and when at the end iodide of potassium is added for the purpose of estimating the amount of permanganate remaining, this chlorine liberates as much iodine as the permanganate would have done which was destroyed in its production, and is thus estimated in terms of permanganate.

for chlorides, under the conditions of the experiment, decompose permanganate, and the chlorine thereby produced is expelled by the boiling, and appears in the final result as organic matter. This permanganate process does not give us the actual amount of organic matter contained in the water examined, nor will it give us even the relative proportions of organic matter contained in different waters, unless the nature of the organic matter is the same, for different kinds of organic matter absorb widely different proportions of oxygen from permanganate. If, however, the nature of the organic matter is the same this process gives us relative quantitative results. Moreover, as I hope I shall be able to show, it is not so much the absolute proportion of organic matter as the relative proportion of oxygen absorbed, that is of value as a guide.

The next process in point of time is, I believe, the so-called albuminoid ammonia process proposed by Wanklyn, Chapman and Smith. This process has for many years enjoyed, and still enjoys, a very wide popularity in this country, in spite of the frequent attacks to which it has been subjected. This popularity is owing in the first place, I have no hesitation in saying, to the intrinsic merits of the process, but in the second place undoubtedly to the comparative ease with which it can be applied; and let us not be too ready to sneer at those making use of a process because it is easy to carry out. Ease of manipulation often means accuracy of results, or at least uniformity of results, which in most analytical processes is the great desideratum. The albuminoid ammonia process gives us, as most of you will know, in the first place the amount of free ammonia present in the water, and in the second place a certain, or perhaps I should say an uncertain proportion of the organic nitrogen, also in the form of ammonia, and this latter is known as albuminoid ammonia. The proportion of the total nitrogen yielded in this form by various kinds of organic matter undoubtedly varies within very wide limits, and it would be easy to make up two samples of water of which the one containing the least amount of organic matter would yield by far the greater proportion of albuminoid ammonia. In practice however this objection loses much of its force. The organic matters found in natural waters, although no doubt they differ from each other, do not range through the whole series of organic compounds and, as a rule, show a considerable degree of similarity, particularly when waters from similar sources are compared with each other, and the experienced analyst will not easily be misled by such variation. Moreover, let me emphasize once again, that our estimate of the quality of a water depends, in great measure, on a comparison between similar waters.

The last process, as applied to non-living organic matter contained in water, I propose to glance at, is the so-called organic carbon and nitrogen process devised by Professors Frankland and Armstrong. The process, when carried out skilfully, gives very good results as far as organic carbon is concerned; the results are less satisfactory in regard to organic nitrogen, particularly in the presence of much nitric acid. The process does not, as little as those previously considered, give us the actual amount of organic matter contained in the water analysed, inasmuch as it takes account of only two of the elements, but those, certainly the most characteristic, and leaves the rest out of consideration. It gives us, however, with a considerable degree of accuracy, the *actual* amount of one of the two elements, namely, the carbon, and that of the second, the nitrogen, with a more or less close approximation to the truth. In this respect the process has certainly the advantage over those previously considered. This advantage is, however, at present, to a great extent neutralized by the fact that the material at our disposal which can serve as a guide is incomparably smaller than that available in regard to the other two processes; and also by the far greater trouble and difficulty involved in its application. The former disadvantage will probably gradually diminish; the latter, however, will remain, and will act as a bar against its general adoption, as long at least as its superiority over the other process alluded to as a method of practical water analysis, is not definitely established, which can hardly be said to be the case at present.

Not improbably the estimation of organic carbon and of organic nitrogen will in future be carried out in two operations. Both estimations will thereby gain in accuracy, and the two processes can be carried out more readily in ordinary analytical laboratories than can the original process. Detmar's process for organic carbon and nitrogen; Dupré and Hake's organic carbon process; Kjeldahl's organic nitrogen process.

Thus far the analytical processes shortly passed in review deal with mineral and non-living organic matter merely, and on the whole they fulfil the object for which they were devised in a very satisfactory manner. When once, however, it was recognised that the injurious effects produced by the drinking of impure water were due not so much to the dead organic matter it contained as to the presence in it of living organisms, the importance to be attached to the dead organic matter naturally diminished.

This dead organic matter hence has occupied a position practically similar to that previously occupied by nitric acid, chlorine, &c., that is, the presence of the dead organic matter might in most cases be taken as an indication of the presence, or possible

presence, of living organisms also. It was then that doubts began to be expressed as to the value of water analysis; some, I believe, going so far as to deny its value altogether. This doubt is, I think, best expressed by Dr. Buchanan in his report to the Local Government Board for 1881. In this he states, "The chemist can, in brief, tell us of impurity and hazard, but not of purity and safety. For information about these we must go, by the aid of what the chemist has been able to teach us, in search of the conditions surrounding water courses and affecting water services."

Now taken in the abstract there can, I think, be no doubt that Dr. Buchanan is right; but in practice this principle should not be applied too rigidly. There can of course be no doubt that an artificially polluted water may be prepared which, while containing an amount of infectious material which would render the water dangerous to those drinking it, would yet be passed as pure by the analyst. In practice, however, such cases very rarely occur, and ought never to occur. As a general rule the proportion of infectious matter that finds its way into a well or water-course is extremely small compared with the amount of non-infectious matter that finds its way into the same; and hence whilst the analyst might be unable to discover the presence of the infectious matter, if it alone were present, he will as a rule have no difficulty in detecting the presence of organic matter, or of products of its decomposition or those accompanying it, due to the far larger proportion of non-infectious material which has entered the well or water-course, &c. Such cases as that of the well at Caterham are, it is to be hoped, extremely rare. They are of the utmost value as showing how small a proportion of infectious matter may prove dangerous, but they must not be taken as proving that chemical analysis by itself is valueless. They should however teach this lesson to the analyst: whenever his analysis shows him undoubted indications of present or past pollution he should condemn the water, or rather, I should say, he should condemn the well or spring, &c., from which the water came, bearing in mind that the non-infectious matter, the presence of which can be proved, indicates the possibility of the presence of infectious matter, the presence or absence of which he cannot at present demonstrate.

The question yet remains to be answered: when, if ever, are we justified, from the results of chemical analysis, in pronouncing a water free from pollution and safe, and when must we pronounce it polluted and unsafe? This lies at the root of the matter, and is by far the most difficult question that comes before the analyst. The mere working out of an analysis is,

comparatively speaking, a simple matter: it is the true interpretation of the results obtained that tasks the knowledge and experience of the analyst.

This difficulty was felt very early in the progress of water analysis, and many attempts have been made to overcome it by laying down certain general standards to judge by, and waters were divided into good, bad and indifferent.

Against the setting up of such general standards I have already repeatedly raised my voice, and wish to do so again before this Section. All such standards are fallacious: they serve only as crutches, so to speak, for the ignorant to lean on; the chemist who thoroughly knows his work does not require them, and those who do require them are not fit to undertake water analysis at all. It is the existence of these general standards that so frequently leads to mistakes. One sample of water is condemned because it contains a little more organic carbon, or yields a little more albuminoid ammonia, or absorbs a little more oxygen from permanganate than has been laid down as a standard, while another water is cheerfully passed because in these particulars it falls within the standard; and yet the first water may be perfectly wholesome and unpolluted in the proper sense of the term, while the second may be entirely unfit for use. As long as we are dealing with definite compounds or with non-living organic matters, however injurious they may be, it is always possible to state a quantity below which, if taken, they will not prove injurious; and general standards may have been of use. The moment however that we are dealing with living organisms capable of self-multiplication, this ceases to be the case, for what may be an infinitesimal quantity in the water may become a dangerous quantity in the body of the consumer. As long however as we cannot by analysis detect the infectious living matter, we must have some guide for drawing correct conclusions from the results of our analysis; and even should we gain this power, chemical analysis and the necessity of its true interpretation will not lose their value; and in fact the analyst who bases his conclusions solely on the presence or absence of dangerous organisms, commits the same mistake as he who only regards organic matter and neglects mineral matter derived from organic matter. For at the time of examination a water may not contain any infectious matter but may nevertheless show signs of general pollution, and thereby show that infectious matter may find its way into the water. What guide then do I recommend? For some kind of guide we must have. This guide was first, I believe, strongly insisted on by my friend Mr. Hehner and myself, in a paper read before the Society of Public Analysts in February, 1883.

It is the conformity of the water to, or its divergence from, the general character of the waters of the district from which it comes, or of the geological formations from which it springs, which from their position and surroundings may fairly be taken as unpolluted. In other words, district standards instead of general standards should be used.* This of course implies a knowledge of district standards, and these are not always easy to obtain, and the obtaining of them frequently necessitates the co-operation of the Sanitary Engineer to select the unpolluted samples; such co-operation is in every respect desirable, and should always be had recourse to in important cases. I freely confess that I have repeatedly been saved from error by such co-operations. District standards might also be obtained if analysts in all parts of the country would freely communicate their analytical results to their professional brethren. In the paper previously referred to we appealed for co-operation in the establishment of such standards to the members of our Society; professional jealousy, however, stands in the way. Perhaps this Society might give effective aid towards the accomplishment of so desirable an object by collecting and publishing standard analyses from all parts of the country from which they are obtainable. By the aid of such district standards, the analyst has, as a rule, no difficulty in giving an opinion regarding the purity or impurity of any water submitted to him, although he may not be able to prove the presence or absence of infectious matter. In the before mentioned paper several series of analyses are given of water collected along the Undercliff, I.W., which clearly demonstrate the polluted character of waters which, on the strength of any conceivable general standard, would have been pronounced as perfectly pure.

I cannot leave this subject without recording my high appreciation of the value in this respect of the sixth Report of the Royal Commission on Rivers Pollution.

Biological Methods.

I have already several times had occasion to allude to the fact that the injurious effect of polluted water is, in all probability, not to say certainty, due to the presence in it of living

* It is of course desirable, when possible, to collect the waters to be used as standards simultaneously with the suspected sample; but this is not absolutely necessary. It is one of the characteristic features of unpolluted waters, particularly in the case of deep wells, to remain practically uniform in composition through considerable periods of time, and a carefully chosen district standard will therefore remain available for some length of time.

organisms. Attempts have accordingly been made to detect these organisms, and a considerable degree of success has been achieved in this direction. Most careful water analysts have for many years been accustomed to the use of the microscope in the examination of water, and very often valuable results were thereby obtained. The first, however, who, so to speak, aided the microscope by adding a cultivating material to the water was, I believe, Mr. Charles Heisch. Mr. Heisch added some pure cane sugar to the water and examined the fungus found growing in sewage polluted water, in consequence of this addition, microscopically. The process has quite recently been again taken up with promising results. The best known biological method is, however, that brought forward by Professor Koch, of Berlin, which consists in adding a small but known quantity of the water under examination to a gelatinizing cultivating material. This mixture is spread on glass slides and examined after a time. If the water is free from organisms no growths make their appearance in the cultivating material, whereas, if the water contained any living organisms, or the germs of such organisms, these will grow and multiply, and thus become visible, each centre of growth corresponding to at least one germ or mature organism, and the number of such germs or organisms in a given bulk of water very approximately ascertained, and special organisms may even be identified. This method has been taken up warmly in this country by Dr. Percy Frankland, who has already published a number of valuable papers on the subject, and who, I am happy to see, is here and will favour us with a paper, and also by Dr. Bischoff and others, and we may look forward with confidence to valuable results from their hands. In theory nothing could well be better than this method; in practice, however, serious difficulties will have to be overcome before this method can be pronounced thoroughly reliable. Thus, some of these organisms grow best in the dark, others require light; some grow only at a moderately low, others only at a moderately high temperature; some like one, some another cultivating material. Hence the number of centres which one and the same water will yield may vary with all these conditions, and some kinds of organisms may not appear at all under one set of conditions, which appear in abundance under a different set of conditions. All these points, as well as others not mentioned, will have to be studied and cleared up before the method will become generally available.

A second biological method which I should like shortly to bring before you is one of my own, but for the working out of which, as far as I have gone, I am strongly indebted to aid afforded me

by Dr. Buchanan. As a chemist it has always been my endeavour to use chemical means in my researches, in preference to any other, whenever possible. Accordingly when the question of these micro-organisms came forward I sought for chemical means for their detection, and I believe I have to some extent succeeded. The method adopted still requires a great deal of work to be expended on it, and I bring it forward here in the hope of inducing some of those present to take it up. The subject is too large for one worker, who moreover is otherwise busily engaged, to work it out in any reasonable time. The process will be found fully described in the reports of the Medical Officer of the Local Government Board for the years 1885 and 1886. Shortly stated it is as follows. If a pure, thoroughly aërated water be kept out of contact with air for say ten days, it will be found to have remained fully aërated. The same will be found to be the case even with an impure water, provided the water contained no living organisms. Sewage polluted water when sterilized by heating remains fully aërated. If however the water contains living organisms, the state of aëration will alter, and in the majority of cases will diminish; and the degree of diminution will give some measure of the number of organisms present. The experiment may be varied by adding some sterilized cultivating material to the water previous to bottling, by keeping the water at various temperatures or varying the amount of light to which the bottle is exposed during keeping, &c. Again, some kinds of organisms are killed in all their stages of development when heated to a comparatively speaking, low temperature; others, particularly in certain stages of development, are capable of withstanding a comparatively high temperature without losing their vitality. By thus varying the conditions of the experiment it becomes possible not only to distinguish, by chemical means, between dead and living organic matter, but even different kinds of organisms may be distinguished from each other.

There is one other question connected with water I should wish to allude to, as it has scarcely received the amount of attention from chemists that it deserves, namely, the action exerted by some waters on metals, notably on lead and on iron, these being the principal metals used in connection with water supplies, &c.

Action on Lead.—Up to within the last few years it was generally supposed that the action exerted by some waters on lead was due, mainly, to their softness, that is, chiefly to the insufficient proportion of lime salts they contained. In addition to this, the main cause, it was ascribed to the presence of nitrates, nitrites, organic matter, &c. Within the last few

years, however, an elaborate research has been undertaken by Drs. Tidy, Odling and Crookes, by which they were led to the conclusion that the real protective agent, that is, the agent which prevented the action of water on lead, was silica. According to this explanation, waters will act on lead if they do not contain a sufficient proportion of silica. They will not act on lead if a sufficient proportion of silica be present, not less than half a grain per gallon, whatever, speaking broadly, the rest of the constituents might be. Drs. Tidy, Odling and Crookes have brought forward many facts tending to bear out their contention; and although they have not, in my opinion, quite proved their case, they have at any rate made out a strong case for investigation, and in future analysts will do well to direct their attention to this point. The question is one beset with difficulties, inasmuch as so many factors have to be taken into consideration before a definite conclusion can be arrived at. The chief points to be kept in view are, in my opinion: The reaction of the water, whether acid, neutral, or alkaline, the most delicate reagents to be used for detecting the same; if the reaction is acid, the amount of this acidity, and if possible its nature; the amount of free carbonic acid; the total dry residue; the proportion of lime and magnesia salts in this; the proportion of chlorine; the proportion of nitric acid; organic matter; and lastly, the amount of silica. It is only by taking all these points into consideration that a satisfactory final result will be arrived at.

Action on Iron.—This has not received anything like the attention which has been bestowed on the preceding question; mainly I suppose because iron not being a poisonous metal, a slight degree of action may be, and generally is, overlooked. In not a few cases, however, the action is so powerful as to constitute a serious nuisance, leading sometimes to considerable expense. This action is observed mainly in connection with a hot water supply, and is, in my experience, due chiefly to the presence of an excess of magnesium salt, particularly of chloride of magnesium. The action may be prevented, or at any rate greatly reduced, by submitting the water to Clark's process. Of course pipes other than iron may be employed. The selection of the kind of pipe to be taken is, however, of some difficulty, particularly in cases in which expense is an object, and the thorough treatment of the question well merits the attention of the sanitary engineer and the chemist.

While I am on this question I may mention another frequent cause of the corrosion of water pipes. This is the setting up of galvanic action whenever two kinds of metal are brought into contact. As far as possible the use of different metal in water

conduits should be avoided, and where it cannot be avoided the two metals should be kept from metallic contact by the interposition of a non-conducting material.

SEWAGE.

I have often thought, and have given public expression to the thought, that, from a sanitary point of view, the production of sewage, ordinarily so-called, that is the water carriage of our house refuse, was a mistake. However, for good or for evil, the plan has been adopted, and we must do the best we can for its satisfactory disposal. The question is a very large and important one, and I cannot treat it in any but a very fragmentary manner here.

The first point I would mention is, that all authorities who have to deal with the disposal of sewage should clearly understand that sewage is a nuisance to be got rid of, and not a thing to make a profit out of.

The next is, that if sewage is to be disposed of to the greatest advantage of the community, the sewage of every place will have to be dealt with on its own merits; no general scheme will do equally well for all.

Many schemes—good, bad and indifferent—have been elaborated for the proper disposal of sewage, but I cannot deal with them here; perhaps we shall hear something about them at this meeting. But with your permission I will throw out some suggestions on the general aspect of the question.

In the first place, I am decidedly of opinion that whatever scheme may be adopted (except destruction of the sewage material by fire), the agents to which the ultimate destruction of sewage is due are living organisms (not necessarily micro-organisms), either vegetable or animal. If this be so, our treatment should be such as to avoid the killing of these organisms or even hampering them in their actions, but rather to do everything to favour them in their beneficial work. Now in order to avoid this danger, and at the same time reduce to a minimum the nuisance due to the existence of sewage, we must begin our treatment in the sewers themselves, a step further back than it is usually begun. Of course I am aware that sewers are laid out with a view of bringing the sewage in the shortest possible time from the sources of production to the general outfall; but even in towns of moderate size the time elapsing in the passage of the sewage between these two points is sufficient to render the sewage offensive, at least in summer time, while in large towns the sewage has time to become very highly offensive. No doubt the great bulk of the sewage as a rule reaches the outfall in a short time, but the time which has to elapse before the whole of

the sewage contained in the sewers at a given time is discharged is far longer than is generally supposed. This offence ought to be avoided; how can it be done? It should not be done in a manner to destroy our beneficial organisms, or even seriously to check their action; in other words, the use of disinfectants or of powerful antiseptics should be avoided. I have the less hesitation in saying this, because, on the score of expense, it is practically impossible to really disinfect infectious matter when once it has found its way into the sewers. All that is usually done in this direction is really a deception—no doubt a self-deception—on the part of those employing such means. All we can therefore really do is to deodorise the sewage, and this can be done without in the least interfering with the immediate or subsequent action of the organisms on which we depend for the final destruction of the sewage. The best material for this purpose is, in my opinion, a solution of permanganate of potassium, prepared on the spot from crude manganate by the addition of acids or suitable salts to the same. Sanitarians are, I think, greatly indebted to Mr. Dibdin, of the Metropolitan Board of Works, for bringing, by his energy and courage, the manganates, and consequently also the permanganates, within the reach of practical sanitation. And let it not be supposed that all we effect is simply deodorization of the sewage; but we also in great measure check putrefaction, and thus do away with what seems to be the chief agent in carrying disease germs into our streets and houses, namely, the rising and bursting of gas bubbles from the sewage.

Sewage thus treated will arrive at the outfalls in a practically inodorous condition, or nearly so, according to the amount of manganate used, and is fit for any kind of treatment we wish to adopt, such as:

Sewage farming with untreated sewage.

Sewage farming with sewage clarified by subsidence.

Sewage farming with sewage clarified by precipitation.

Precipitation and filtration.

Precipitation and discharge, if necessary previously deodorised, into a river of sufficient volume to prevent the production of a nuisance. According to the exigencies of each particular locality.

As regards processes of precipitation, I will merely remark that inasmuch as no proportion of chemicals which can practically be employed will do much more than clarify the sewage, the proportion of chemicals employed should be kept as low as is consistent with the object to be obtained, namely, clarification, and that, more particularly, the use of large quantities of lime should be avoided.

To sum up: let natural agencies have their way, assist and direct them into proper channels as far as you can, but interfere with them as little as possible.

Mr. Rogers Field, M.Inst.C.E. (London), moved a vote of thanks to Dr. Dupré for his admirable address. As bearing on the subject matter of that address he might say he had known of more than one case in which water had been analysed by a local chemist and pronounced to be good, when he himself had been nearly certain from the surroundings that it had been polluted with sewage. The discrepancy had been cleared up for him by Dr. Dupré. The opinion that the water was unpolluted was given simply on the general grounds that water which contained only such and such ingredients was unpolluted. But directly a sample of unpolluted water of the district was obtained and compared with the water in question it was found that the water was clearly polluted.

Mr. J. B. Gass (Bolton) seconded the vote of thanks to Dr. Dupré for his admirable address, and remarked on the vital importance of correct and high standards for the purity of water for domestic purposes, as a question, the application of which directly affected the health of the whole population.

Dr. A. Dupré, F.R.S. (London), expressed his thanks for the compliment, and then called on Mr. Frankland and Dr. Parkes to read their papers, saying it would be better to discuss them both together.

On "*The Application of Bacteriology to questions relating to Water Supply*," *by* Percy F. Frankland, Ph.D., B.Sc. Lond., F.C.S., F.I.C., Associate of the Royal School of Mines.

Although the modern development of the study of bacteria and other allied micro-organisms has now attracted the attention of the public for a number of years, and has excited such general interest that references to "bacteria," "germs," "microbes," and the like are frequently to be found in the daily papers and other prints freely circulated amongst all classes of the population, yet it is often only too palpable from these very allusions that but little sound knowledge concerning these micro-organisms has penetrated beyond a comparatively limited circle.

I am, therefore, of opinion that on the present occasion it will not be out of place to point out briefly some of the more important applications of bacteriology to the subject of water supply.

In the first place it may be stated generally that bacteriological science has so far been applied to the investigation of the sanitary aspects of water supply in three different ways:—

1. In the actual detection of disease-producing or pathogenic micro-organisms in potable water.
2. In determining the influence which filtration and other methods of water purification (both natural and artificial) have on micro-organisms in general.
3. In ascertaining the fate of disease-producing or pathogenic microbes when introduced into different kinds of water.

We will deal with these three applications of bacteriology in order:

1. *The detection of pathogenic micro-organisms in drinking water.*

It is frequently and very generally supposed that the all-important task of bacteriology in connection with drinking water is to ascertain whether or not a given sample of water contains micro-organisms capable of producing disease. Now, even assuming that we were fully acquainted with all the micro-organisms capable of producing disease, which we certainly are not, even then the examination of water for hurtful microbes would be a comparatively unimportant application of bacteriology, one possessed of only limited and local interest, and if relied upon alone, capable of leading to most erroneous and dangerous deductions. For instance, of what value would it be to ascertain that a sample of some particular water supply was free from the infectious principle of typhoid fever or cholera on some particular occasion? Information of this kind has obviously next to no interest whatever, for the absence of these infectious principles on one occasion affords no indication that they may not be present at a future time. Imagine the absurdity of examining all the potable waters of England for the specific poison of typhoid fever, and assuming that the poison, if present, could be detected with unerring certainty, how many of the most dangerous waters would escape condemnation because at any particular moment the chance of their containing the poison is infinitesimally small!

It cannot be sufficiently emphasized that the mere detection of zymotic poisons in water is a matter of complete unimportance from a general point of view, and the fact that the detection of

even the few known zymotic poisons is at present a matter of the greatest difficulty, and in consequence of the almost invariable and enormous preponderance of harmless organisms, is really of but little consequence, as the important bearings of bacteriology on water supply lie in an altogether different direction.

It should, however, be mentioned here that the organism which is widely credited with being the producer of cholera was by Koch found during an epidemic in the tank-water used for drinking in India, and quite recently the organism, which is believed to be the *contagium vivum* of typhoid fever, is alleged to have been found in a well-water which had been used by persons suffering from this disease.

It is obvious that this first application of bacteriology to water-sanitation is of far more interest in throwing light upon the manner in which particular diseases may be disseminated than in forming our opinion as to the fitness of water for domestic use. It is in fact of interest rather to the student of disease than to the student of water-sanitation.

2. *Determination of the Influence which Filtration and other methods of water-purification (both natural and artificial) have on micro-organisms in general.*

Inasmuch as a large proportion of all the water available for domestic use has at some period of its history been exposed to the risk of contamination with infectious matters, it obviously becomes a matter of primary importance to ascertain with what degree of probability these infectious matters, should they have gained access to the water, would be removed in the subsequent natural or artificial treatment which the water has undergone.

Now the infectious matters which the systematic investigation of zymotic disease has revealed are in every case micro-organisms, and thus the study of the removal of infectious matters from water becomes synonymous with the study of the removal of micro-organisms from water. But as we are acquainted with only a few of these infective micro-organisms, it is necessary to study the influence of methods of water-purification on micro-organisms in general, irrespective of their hurtful or harmless character. On this subject, bacteriology in its present stage of development is capable of throwing the most important light.

In a paper which I had the honour of bringing before the last meeting of the Sanitary Congress at York, I had occasion to point out some of the results which I had obtained in the application of bacteriological methods to the examination of the London water supply. I there showed how the process of sand-filtration, which is employed by seven out of the eight companies supplying the metropolis, is in reality an operation

of the greatest sanitary importance, and not a mere useless formality, as had been generally supposed before.

As every fresh confirmation of these results is necessarily of importance in establishing the truth of this new departure in our views, I venture to bring before you on this occasion the fresh material which I have accumulated in carrying on these investigations for the Local Government Board up to the close of the past year.

In the following table I have recorded the number of micro-organisms, as determined by gelatine-plate cultivation, in the unfiltered waters of the Thames and Lea, as well as in the filtered waters supplied by each of the seven companies drawing from these sources:—

1886.

Total Number of Colonies obtained by Cultivation of one Cubic Centimetre of Water.

Description of Water.	Jan.	Feb.	March.	April.	May.	June.
Thames.						
Thames unfiltered	45,400	15,800	11,415	12,250	4,800	8,300
Chelsea	159	305	299	94	59	60
West Middlesex	180	80	175	47	19	145
Southwark	2,270	284	1,562	77	29	94
Grand Junction	4,894	208	379	115	51	17
Lambeth	2,587	265	287	209	136	129
Lea.						
Lea unfiltered	39,300	20,600	9,025	7,300	2,950	4,700
New River	363	74	95	60	22	53
East London	224	252	533	269	143	445

Total Number of Colonies—continued.

Description of Water.	July.	August.	Sept.	Oct.	Nov.	Dec.	Average.
Thames.							
Thames unfiltered	3,000	6,100	8,400	8,600	56,000	63,000	20,255
Chelsea	59	303	87	34	65	222	146
West Middlesex	45	25	27	22	47	2,000	234
Southwark	380	60	49	61	321	1,100	524
Grand Junction	14	12	17	77	80	1,700	630
Lambeth	155	1,415	59	45	108	305	475
Lea.							
Lea unfiltered	5,400	4,300	3,700	6,400	12,700	121,000	19,781
New River	46	55	17	10	32	400	102
East London	134	243	165	97	248	280	253

In connection with this table it should be pointed out that the figures obtained for the New River Company are not really comparable with those of the East London Company, inasmuch as the New River Company draws from the river Lea at a point many miles above the intake of the East London Company, and its river supply is to a considerable extent diluted with water obtained from deep wells.

If it be assumed that the samples of unfiltered water represent the average composition of the river waters gaining access to the various companies' reservoirs, it is obvious that we can represent the diminution in the number of micro-organisms which has taken place before delivery by percentage figures representing roughly the efficiency of the treatment which the water has received at the hands of the several companies. In the following table this percentage reduction is recorded for each of the companies, excepting the New River, which for the reasons mentioned above is not comparable with the others:—

1886.

Percentage Reduction in the Number of Developable Micro-organisms present in the River Waters before delivery by the Companies.

Description of Water.	Jan.	Feb.	March.	April.	May.	June.
Thames.						
Chelsea	99·7	98·1	97·4	99·2	98·8	99·3
West Middlesex	99·6	99·5	98·5	99·6	99·6	98·3
Southwark	95·0	98·2	86·3	99·4	99·4	98·9
Grand Junction	89·2	98·7	96·7	99·1	98·9	99·8
Lambeth	94·3	98·3	97·5	98·3	97·2	98·5
Lea.						
East London	94·4	98·8	94·1	96·3	95·2	90·5

Percentage Reduction—continued.

Description of Water.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Thames.							
Chelsea	98·0	95·0	99·0	99·6	99·9	99·7	98·6
West Middlesex	98·5	99·6	99·7	99·7	99·9	96·8	99·1
Southwark	87·3	99·0	99·4	99·3	99·4	98·3	96·7
Grand Junction	99·5	99·8	99·8	99·1	99·9	97·3	98·2
Lambeth	94·8	76·8	99·3	99·5	99·8	99·5	96·2
Lea.							
East London	97·5	94·3	95·5	98·5	98·0	99·8	96·5

These results are confirmed by the experience obtained in other places. Thus I have had an opportunity of examining the effect of similar treatment on the water supply of a large town in the north of England. In this case the results obtained were as follows :—

Unfiltered Water.	31,200	micro-organisms found in one cubic centimetre.
Filtered Water.	122	ditto.
Percentage Reduction.	98·0 per cent.	

Results entirely in harmony with these have been obtained in the similar systematic investigation which has for some time past been made of the water supply of Berlin, and the amount of material which has thus been accumulated, both here and in Germany, is now so overwhelming as to place the facts which I have brought before you altogether beyond doubt.

It is, however, of the greatest importance that further investigations of a more detailed nature should be carried out, in order to render the process of filtration less empirical in character and to do away with the occasional irregularities in the efficiency which are apparent in the above tables.

The natural purification of water by filtration through porous strata of the earth may be similarly ascertained provided it is obtained in a continuous stream from the water-bearing stratum without having undergone storage. I may cite as instances of this kind of filtration, which I have had occasion to examine the efficiency of—

1. The underground water of the Grand Junction and Southwark Companies.
2. The deep well water of the Kent Company.

The underground water of the Grand Junction and Southwark Companies, is obtained from the extensive gravel beds which are found in the immediate vicinity of the Thames at Hampton, in fact the water of the Thames is artifically introduced into these beds and then abstracted again after it has traversed them for a horizontal distance of about 100 ft. When I examined these waters bacteriologically some time ago, I obtained the following results :—

Underground Water.	Number of micro-organisms found in one cubic centimetre.
Grand Junction Company	208
Southwark Company	58

Now as the unfiltered Thames water would doubtless contain about 10,000 organisms in the cubic centimetre, it is obvious that the percolation through the gravel beds had in each case effected a very large reduction.

In the case of the deep well water of the Kent Company, which I have under constant observation, the number of micro-organisms in the water as it is pumped from their deep wells in the chalk is generally very small indeed, as seen from the following record for the year 1886:—

Number of Micro-organisms found in one cubic centimetre of Water.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Kent Company's deep well water	...	5	44	7	8	4	12	9	5	82	12	11	18

The occasion when the number amounted to 82 per cubic centimetre was after the well had been under repair, and consequently the regular course of working had become disturbed.

Of course, in the case of natural filtration of this kind it is impossible to say what may have been the original condition of the water, and, consequently, the efficiency of the process cannot be expressed by means of any percentage figure, as was adopted above in the case of artificial sand-filtration.

It is clear, however, that the small numbers obtained in the case of this deep well water really amount, practically, to complete removal of all originally present micro-organisms, since the well, pumps, pipes, &c., used in raising the water cannot be rendered sterile, as would be done in the case of a laboratory experiment, and a small number of organisms must, therefore, be expected in the pumped water, even if the water actually issuing from the strata was absolutely sterile.

3. *Determination of the fate of disease-producing or pathogenic microbes when introduced into different kinds of water.*

As already pointed out, it has only in most exceptional cases been possible to discover the presence of organisms known to be pathogenic in water, it was only natural, therefore, to ascertain experimentally what becomes of such pathogenic micro-organisms when they are purposely introduced into water of different kinds. I have made a number of experiments in this direction, the principal pathogenic organisms which I have employed for the purpose being the *bacillus anthracis*, *Koch's comma spirillum*, and the *streptococcus of erysipelas*. It would be beyond the scope of the present paper to detail the nature of these experiments, which I have fully described in communications to the Royal Society and the Society of Chemical Industry, but I may briefly summarize the results as follows:—

1. The "comma" spirilla were found to flourish and multiply

abundantly in London sewage, whilst in deep well and filtered Thames water, although they were still demonstrable after nine days, they were only present in very diminished numbers. In the sewage the "comma" spirilla were still found to have retained their vitality after eleven months.

2. The bacillus anthracis containing spores retains its vitality, even when introduced into distilled water, for a practically indefinite time, and when introduced into London sewage it undergoes extensive multiplication.

3. The streptococcus of erysipelas was found to possess but little vitality either in potable water or sewage; it was, however, still discoverable in filtered Thames water after five days.

These experiments, therefore, show that, whilst ordinary drinking water does not form a suitable medium for the extensive growth and multiplication of the pathogenic micro-organisms, and that in some cases these forms may undergo more rapid destruction than was formerly supposed, yet, that in the condition of spores, they are extremely permanent in any kind of water, however pure; and that even those of which no spores are known may often be preserved for days, or even weeks. We have thus no difficulty in understanding both how zymotic poisons can be carried by water, as well as how in some cases water known to be infected may fail to communicate zymotic disease. In fact, these experiments prove most conclusively that no reliance can be placed on the spontaneous destruction of pathogenic organisms gaining access to potable water.

It is obvious that the experimental field in this third department of the subject is a very extensive one, and that an almost unlimited amount of work remains to be done both with those pathogenic organisms which are already known, as well as with those which may be discovered in the future.

Finally, I should like to point out a fourth possible, although perhaps not probable, development of the application of bacteriology to questions of water supply, and that is the future discovery of micro-organisms absolutely characteristic of sewage pollution generally. It is obvious that the identification of such distinctive forms would be of the utmost value, as it would enable us to fix upon waters which had received sewage contamination, and had not subsequently undergone such purification as to remove all the organisms which were present in the sewage. Such a test would be of an altogether different order from that referred to in Section 1, for we should condemn water which had undergone sewage contamination, irrespectively of whether the sewage was harmless or infectious; whilst the test referred to in Section 1, and which is frequently supposed to be the ultimate aim of the bacteriological examination of water, would

lead us only to condemn waters which had been contaminated with infective sewage. But if a water is contaminated with harmless sewage to-day, it may be fouled with infective sewage to-morrow; and thus the utter worthlessness of the idea that the aim of bacteriology applied to water consists in discovering pathogenic organisms is apparent.

[*For discussion on this paper see page* 388.]

On "Water Analysis," by LOUIS PARKES, M.D., Public Health Cert. Lond., Assistant to the Professor of Hygiene and Demonstrator in the Hygienic Laboratory, Univ. Coll., London.

THE practice of submitting to an analyst samples of water used, or intended to be used, for drinking purposes, is one undoubtedly much in favour amongst the public. The householder who has read of the dangerous pollutions to which water in wells or cisterns is liable, wishes to know as regards his own domestic arrangements whether the water he drinks is pure and free from suspicion of contamination. He collects some of the water in a bottle and sends it to an analytical chemist for his opinion on the matter. In the course of time a report is received, couched in language and figures unintelligible for the most part to the lay comprehension, but with a few sentences at its termination approving or condemning the water on the results of the analysis; and on this opinion the householder proceeds to act. His faith in the purity of the water is either restored or it is shattered, with the result of his making extensive alterations in the water arrangements of the house, or else seeking a new source of supply. The question therefore of the extent to which chemists and sanitary experts are justified in forming definite conclusions as to the safe or dangerous characters of waters submitted to them for examination is one of considerable interest to the public generally.

Broadly speaking, there may be said to be three methods of examining water, as regards its fitness for domestic use:

1. *Physical Examination*, by which such qualities as its appearance (colour, clearness, lustre), its taste and its smell are determined. No one thinks of relying solely on the colour or smell of a water when he wishes to form an opinion about its

fitness for drinking; so that although this examination, being easily and rapidly made, is always included in every scheme of water analysis, the indications it gives are necessarily only confirmatory of the other results that may be obtained. The microscopical examination of the sediment deposited by a turbid water should also be included in the physical examination; but of this we shall have to speak further on.

2. *The Quantitative Examination of dissolved solids in the water by chemical analysis*, is the second method; and

3. The *Biological Examination*, which is concerned with the quantitative estimation in the water of living micro-organisms belonging to the Bacteria and allied species is the third method.

It will be necessary, owing to the limited time at our disposal, to confine our attention to that aspect of the subject which is connected with the determination of the possible organic pollutions of a water; and, indeed, it is only on this question that any misconception exists. No one denies that the presence of inorganic salts in a water—salts which may render it, from their excessive amount or poisonous natures, unfit for drinking—can be determined accurately by the chemist. The chemist can and does rightly condemn the water which is brackish from infiltration of sea salts, or that which contains excess of lime and magnesian salts, causing an undesirable or positively injurious amount of hardness, or the water which in its passage through various strata may have taken up traces of lead, copper, or arsenic. In such cases as these there is no room for controversy, but it is in those cases where an opinion is desired on the nature and extent of the organic pollutions that a water has been subjected to, that the scientific mind has been so deeply stirred. The question is not yet settled, nor is it likely to be, until our knowledge is more extensive and more accurate; but in the meantime a review of the matter in its larger aspects may not be out of place.

Firstly, it will be well to consider what it is the analyst wishes to determine when he is dealing with the possible organic pollutions of a sample of water submitted to him. He wishes to determine (*a*) the amount of organic matter present in a measured volume of water, and (*b*) the nature of this organic matter, *i.e.*, its source or origin, and its potentialities for evil. Does chemical analysis enable these two apparently simple points to be correctly determined? First, as regards (*a*) the amount of organic matter present. No one who has looked into the subject at all needs to be told that no simple method of estimating organic matter has yet been devised. There is no reagent which can be used as a quantitative test for organic matter, for the simple reason that there is such a numberless

variety of substances all conveniently included under the generic term "organic," that no single chemical reagent could possibly have the same affinities for all of them, and consequently whilst it might give correct indications of the amount and presence of one or more of them, it could not possibly do so for all. No doubt the Potassium Permanganate solution can—as the test is now carried out—be trusted to estimate approximately the amount of *oxidisable* organic matters present in the water. But those matters which are oxidisable by Permanganate of Potassium solution are not the only matters of organic origin which may be present; we do not know what proportion they form to the total organic matters, nor do we know whether their deleterious properties are greater or less than those of the non-oxidisable matters.

Failing in our efforts to identify organic matters *as such* in a water, two methods have been devised for their estimation from the amounts of some of their constituents—processes involving in the one case the breaking up of the complex organic molecule into the simple compound ammonia, by means of destructive distillation with a strongly alkaline solution of permanganate of potassium; and in the other the resolution of the organic matter into its primitive elements carbon (or more accurately carbonic acid) and nitrogen, by means of heat applied to the dry residue obtained from a measured volume of water by evaporation. The first process—the joint invention of Wanklyn, Chapman, and Smith—is known as the "albuminoid ammonia process," because albumen is one of the principal substances which yield ammonia on distillation with an alkaline solution of permanganate of potash. The second, or combustion process, is due to the inventive genius of Frankland and Armstrong. There can be no doubt that theoretically, and considered from a philosophical standpoint, Frankland's process should give better results than Wanklyn's. In the former, all the organic matter present is acted upon—none can escape. In the latter, the whole of the nitrogen contained in the nitrogenised organic matters is not converted into ammonia, for whilst permanganate of potash acts powerfully on some kinds of organic matter, it has little or no effect upon others, and the non-nitrogenised organic matters are left out of account altogether. Thus the results obtained have not an absolute significance as they have in Frankland's process, but only a relative. Is this a drawback in actual practice when Wanklyn's process is in use? From Dr. Cory's experiments* it would appear that it is, for he found that the results of different analyses were not comparable with each other except

* Report of the Medical Officer of the Local Government Board, 1881.

under certain conditions, as when the polluting material was of the same nature in all; but on the other side plenty of evidence is to hand showing that under the conditions met with in actual practice the process is to be relied on, especially in estimating those very minute quantities of organic matter which alone are usually found in natural waters. I would more particularly refer to the experiments of Mr. Cassal and Dr. Whitelegge* on the quantitative estimation of egg—albumen in water by Wanklyn's process—experiments which throw some doubt on the conclusions arrived at by Dr. Cory from his own experiments. When the polluting ingredients are relatively very large in amount, there can be no doubt that considerable increases or decreases in the amounts of organic matter are not shown in an exactly proportional increase or decrease of albuminoid ammonia. But this is not a matter of practical importance, for if it is right to condemn a water which shows more albuminoid ammonia than the minimum taken as a standard by Wanklyn from his own experience, then it cannot much matter whether the albuminoid ammonia exceeds by 50 times or only by 20 times the allotted amount. Wanklyn's process is easily learnt and easily worked, whilst Frankland's is most difficult: except in the hands of the most expert it may give an error of experiment greater than the total quantity to be measured.

But after all it is not the amount of organic matter in a water which renders it harmful, but its kind; and hence the folly of setting up a minimum standard, as Wanklyn has done, for every adversary to tilt at. Our food consists very largely of organic matters, and we ought not to object to taking food and water together, were it not that experience has shown that the organic matter in water is often derived from food materials which have already once passed through the human body, acquiring thereby a potentiality for mischief not to be lightly risked.

We have seen then that chemical processes enable us, in one way or another, to estimate the amount of organic matters in a water—more or less roughly it may be, but still sufficiently for the purpose. Do they give us any information as to the kind of organic matter present? To a certain extent they do; for by their means we can in most cases discriminate the origin of the organic matter, that is to say, its derivation from the animal or vegetable kingdom. When the pollution is of vegetable origin, chlorides and free ammonia are usually present to

* Remarks on the analysis of water for sanitary purposes. Transactions of the Society of Medical Officers of Health, 1884.

only a slight extent. By Frankland's method under such circumstances it is found that the ratio of organic carbon to organic nitrogen is high, whilst by Wanklyn's the proportion of albuminoid ammonia to free or saline ammonia is relatively large. When the pollution is derived from an animal source, and more especially when it is derived from sewage infiltration, owing to the large amount of common salt and ammonia from decomposed urea found in urine, chlorides and free ammonia are present in excess, the free ammonia that is distilled over greatly exceeds the albuminoid ammonia, and the ratio of organic carbon to organic nitrogen is low. Microscopic examination of the sediment greatly aids in this determination. In the one case fragments of decaying vegetable structure and the minute forms of aquatic life which find a habitat in such materials may be found; whilst in the other, objects such as fibres of linen and cotton, hairs, epidermic scales, &c., which are characteristic of excretal and waste refuse, may be discerned. It is possible then in most cases to distinguish by chemical processes, with the aid of the microscope, between pollutions of animal and vegetable origin; and this distinction is an important one, for there can be no doubt that pollutions caused by sewage infiltration, by soakage from graveyards, or by decomposing animal bodies, are infinitely more dangerous than the pollutions arising from decaying plants and the organisms that thrive amongst them. But these latter must not be thought of as harmless. Ague, intermittent fevers, and dysentery are propagated by drinking vegetably-polluted waters, and we cannot tell whether the specific virus of one of these disorders may not be lurking amongst the more innocent matter.

Supposing it to be allowable to pass as satisfactory a water contaminated to a slight extent with vegetable matter—on the ground that such waters can usually be drunk without the slightest fear of injury, and that therefore a minimum standard of pollution under such circumstances may be a very necessary thing,—it must be admitted that there can be no reason why a water which is reasonably believed to be polluted with sewage or other animal emanations should not be condemned at once, however small the pollution may be. It may be said that large numbers of people are continually in the habit of taking sewage into their systems along with their drinking water—the circular system of water-supply from cesspool to well, and again from well to cesspool through the human body being all too common,—but all scientific history proves that such people are walking on the brink of a precipice which may at any time crumble away and precipitate them into the depths below. The difficulty in water analysis is, in many cases, to distinguish between

sewage pollutions and other conditions which are characteristic of pure natural waters. Unless the source of the water is known, a deep well water may easily be conceived to be a water polluted at some former period with sewage, and therefore liable to further contamination, and consequently dangerous.

Chemical analysis enables us to determine, by a quantitative estimation of the nitrates and nitrites, whether a water has been polluted with animal organic matters at a former period. By the action of nitrifying bacterial organisms, water in its passage through the soil is purified—the organic matter is converted into nitrates and nitrites of the alkaline earths. Many deep well waters of the purest kind organically are thus known to have been originally derived from polluted sources; but they have become purified by filtration through the immense thicknesses of soil and rocks that they have traversed in their passage from the surface of the earth. A "previous sewage contamination," as it has been termed by Frankland, is a matter of no practical importance, as regards the fitness of a water for potable purposes, so long as it occurred at a sufficiently remote period to leave the quality of the water at the present time unaffected by it, and provided that it does not occur again. On this latter point of course chemistry can tell us nothing.

Chemical analysis can detect and estimate very minute traces of organic matter in water; but can it help us in those cases where, although the amount of pollution has been almost infinitesimal, it has been sufficient to cause widespread outbreaks of disease? Such cases have occurred at Caterham, where, according to Dr. Thorne Thorne,* more than one and a half million gallons of water were in a fortnight rendered capable of propagating typhoid fever by the infected discharges of one man. Again at Plymouth, in Pennsylvania, the excrement of one typhoid fever patient which had been thrown upon the snow near a stream which supplied the town reservoir, was sufficient to cause a widespread epidemic amongst the consumers of the water. This water, we are told, was chemically the purest of the three sources of supply for that town.† It does not appear that the Caterham water was analysed at the time of the outbreak; but supposing the facts to be as recorded, the pollution is evidently so infinitesimal—much less than one grain of polluting material to the gallon—that there must have been a failure to identify it as a dangerous pollution by chemical analysis. We can only conclude then that such cases, when they occur, are beyond the reach of chemistry. They are very

* Report of the Medical Officer, Local Government Board, 1879.
† Sixth Annual Report of the State Board of Health of New York.

similar in character to those where artificially manipulated waters have been submitted to a chemist for his opinion, and he has failed to detect the pollution. But these infinitesimal pollutions are very rare in practice; in ninety-nine cases out of a hundred, specific pollution of a water occurs along with such gross pollution by other organic filth, either recent or at a former period, that the chemist cannot fail to detect it. We may conclude, then, that there are cases where a chemist may pass a dangerous or actually disease-productive water as pure, but that such cases in actual practice are very rare; and that it is not right to condemn a method altogether because it fails under a very rare combination of circumstances. The failure really lies in the inability to distinguish between the different kinds of organic matter, between the dead and living, the noxious and the innocuous. The chemist can tell us none of this; we must remain satisfied with the information he can give as to the amount of polluting material and its probable derivation from the animal or vegetable kingdom. As Dr. Buchanan has said, "the chemist can tell us of impurity and hazard, but not of purity and safety."

The biological examination of a water by what is known as Koch's gelatine-peptone test has been thought by many to be capable of supplying that information as to the number and nature of the living micro-organisms in a sample of water which we have seen that chemical analysis is unable to furnish us with. It is desirable to consider a few points in connection with this new method, upon which so many hopes have been founded. In the ordinary microscopic examination of water little can be learnt unless there is enough sediment deposited to form a distinct object in the field of the microscopic lens. In this field various microscopic animalculæ may be seen, and where putrefactive changes are in progress the different forms of bacterial life always associated therewith may be observed under a high power. The cultivation test is not concerned directly with any of these larger microscopic objects, but aims at developing on the cultivating medium the germs or spores of the fungi or bacteria present in the water (but not to be detected in the ordinary way by the microscope) into isolated colonies, which after a certain period of growth are quite visible to the naked eye, and present more or less characteristic microscopic appearances. A pure cultivation of any one of these colonies may subsequently be made on a sliced potato, or in a test-tube containing sterilised broth or peptonised gelatine, and the mode of growth in these media determined; or the colony may be submitted directly to examination under a high power of the microscope.

There can be no doubt that the dangerous properties of polluted water are due not to the dead organic matter it contains, but to the living micro-organisms always found in association with dead matters. The proof of this is known to everybody. When a suspicious or dangerous water is boiled for a few minutes it is rendered harmless. The organic matter is not destroyed—it is still there, and can be detected, as before, by chemical analysis — but the living organisms are killed. Koch's cultivation-test enables us to estimate approximately, in any sample of water, the number of germs which, when cultivated on peptonised gelatine under ordinary conditions of light, moisture, and temperature, are capable of forming well-defined colonies. In so far then as this test gives information as to the amount of organic life in a sample of water, it tells us what chemistry cannot. But it must be remembered that there are many micro-organisms—and amongst these many pathogenic micro-organisms, whose presence or absence in a water we are most particularly concerned about —which cannot grow in peptonised gelatine; they must be cultivated in broth or blood serum, or some other medium. There are others which do not grow at ordinary temperatures, or which only grow in darkness, or which can only be cultivated under a variety of conditions not to be found in the ordinary method of employing the test. The conclusion to be arrived at, therefore, is that the gelatine-peptone test can only afford partial information as to the number of microphytes in a water: the results of one examination may be and no doubt are directly comparable with those of another conducted under like conditions, just as albuminoid-ammonia results are comparable with one another—but this is all that can be said.

Is there any relation between the amount of organic life— the number of "centres" or "colonies," as determined by the gelatine-peptone test—and the amount of organic matter as determined by chemical analysis? According to Professor Bischof * there is, when the samples are examined without any delay. In a chemically-polluted water the number of colonies is enormously in excess of those found in a chemically pure water. But should the examination be delayed, the influences of storage and temperature come into play. Under suitable temperatures (20° C. to 40° C.) an enormous development in the number of microphytes takes place, even in a water so chemically pure as the New River Company's supply to London, when stored for a few days. This is the more remarkable, as it might be supposed that so pure a water did not contain suffi-

* Transactions of the Society of Medical Officers of Health, 1885-86.

cient nourishment to enable an enormous multiplication of living micro-organisms to take place. An analogous circumstance, which is capable of explanation as above, is well known to those who practice Wanklyn's method. When a somewhat polluted water is analysed a second time, after keeping a few days, it is found that the free or saline ammonia has considerably diminished, whilst the albuminoid ammonia has increased. The ammonia has served to nourish the microphytes, and enabled them to undergo enormous development—a fact made known to the analyst by the increase of albuminoid and corresponding decrease of free ammonia.

The next question which suggests itself is—has the number of colonies as determined by Koch's test any relation to the possible dangerous properties of a water? The answer must be no: no more, but probably less, than the amount of organic matter has. In the first place, the greater number of micro-organisms known to us belong to harmless species; secondly, experience shows that water when properly stored in houses or on board ship does not acquire any harmful properties thereby, although the number of its contained microphytes may have increased a hundred or even a thousand-fold; thirdly, there is good reason to believe that microphytes, like the higher animal species, have to fight amongst themselves for the nourishment they require for their continued existence. Hence an enormous multiplication of colonies may mean that the harmless species, always in excess, have entirely exterminated their pathogenic *confréres*. May this not be the explanation of the very remarkable fact that although the specific poisons of enteric and other fevers are constantly passing into the Thames but a few miles above the water companies' intakes,* yet no evidence has ever been forthcoming of disease traced to the quality of the water supplied by any of the Thames companies from Thames Ditton or Moulsey? Evidently the specific poisons do not multiply in Thames water; probably they are forced out of existence in the struggle for life with the countless species of innocuous bacteria which abound in the Thames, aided by the purifying influences of dilution and oxidation.

Failing to extract any satisfaction from the number of colonies, we may next inquire if Koch's test gives any information as to the nature of the colonies, and if it enables us to distinguish pathogenic from non-pathogenic forms. In examining a cultivation plate it is possible at once to distinguish

* The sewage of Staines passes untreated into the Thames 10 miles above Moulsey, (West Middlesex, Grand Junction, Vauxhall, Lambeth and Chelsea).

certain moulds and fungus-growths, and also to discriminate between the liquefying and non-liquefying centres—those, namely, which in the course of their growth liquefy the gelatine and those which do not. It has been assumed that where the number of liquefying colonies is large in proportion to the whole number, it is a sign of possible danger. The assumption is groundless if we are to believe, as Bischof and Klein tell us, that liquefying centres are due to the growth of motile bacilli—bacilli which are always found in excess where oxygen is abundant, and which are consequently more numerous in the top strata of water, which are exposed to the air, than in the deeper layers. The motility of a bacillus is not necessarily evidence of disease-producing properties. Many of the colonies in a plate cultivation may be identified at once or by subsequent processes as belonging to more or less common harmless species; but the number of pathogenic species could not be ascertained, even if they were all capable of growing in gelatine, because we do not know yet as regards the diseases most often spread through water, viz., cholera, typhoid fever, diarrhœa, dysentery, ague, &c., how to identify the organisms which play the rôle of specific virus, or carriers of specific virus, in these affections. It is perhaps allowable to except cholera from this category, as the mode of growth and other characteristics of Koch's comma bacillus are now well known, and Koch himself has isolated the bacillus from a water-tank in India. But cholera happily is very rarely prevalent in this country; we may indeed almost hope that cholera visitations are not likely to occur again on an extensive scale, so minute are the precautions taken to stamp out the disease as soon as imported. The fact then remains that as regards the diseases most commonly spread through the agency of drinking water—and in this list might also be included the common zymotic fevers in which a mode of propagation by water has not yet been disproved—the specific organisms, which are believed to stand in relation to them as cause and effect, cannot be identified by any method of biological cultivation as yet known. With the advance of knowledge such identification may become possible, but the labour of investigation in any case must be enormous. Every colony not recognised at once by its naked-eye characters, must be prepared afresh as a pure cultivation in test tubes of gelatine, in blood serum, or on potatoes, until a place has been found for it amongst one of the numberless species known to the microbiologist; and, failing this identification, inoculation into the lower animals must be practised, to determine if possible its effect on the animal body. Even inoculation experiments on the lower animals are misleading, for many specific diseases to

which man is liable are not represented by any corresponding affection in the lower animals, and *vice versa* many specific febrile disorders of the lower animals are not transmissible to man. The difficulties in the way of the proper development of the biological cultivation tests for water are immense; they are certainly not insuperable, for it must be remembered that we are at present only on the threshold of this particular branch of knowledge. In the meantime whilst the pursuit of such methods should be persisted in for the sake of the advancement of knowledge, it must be acknowledged that they afford very little help to the water-analyst in enabling him to form a sound judgment on the wholesomeness or otherwise of a water submitted to him for examination.

There is one other method of examination that should always be practised whenever it is possible. This may be called the "sanitary survey of the source of the water." It is not sufficient for the analyst to be told that the sample of water submitted to him was taken from a deep or shallow well, from a cistern, or from a water pipe. He should make careful observations, in the case of a well, as to its depth, mode of steining, the nature of the soil in which it is sunk, the distance from the well of possible sources of pollution (cesspools, drains, and sewers); and in the case of a shallow well he should try to determine the direction of the flow of the underground water, whether from possible sources of contamination to the well, or in the opposite direction. If he is not satisfied as to the freedom of the well from all suspicion of contamination at every period of the year, he should insist on further analyses being made during or after periods of heavy rainfall, or at such other times as he thinks it likely pollution may occur. A physical examination of the source of the water, conducted as above, will materially help the analyst to put a right interpretation on the results of his analysis; and he will not then be liable to commit the serious error of passing as wholesome a sample of water which is taken from a source, pure perhaps at the time the sample was taken, but threatened with a dangerous pollution, not to be foreseen except by actual inspection of all the surroundings.

When a sample of water is taken from a house cistern, an inspection of the place and manner in which the water is stored is most urgent. If the overflow pipe of the cistern is connected directly with the soil drains, it is possible to imagine that the water thus stored, whilst not giving sufficient evidence of sewage contamination to warrant its condemnation by the chemist, may yet be most potent for mischief, for it may be specifically contaminated with sewer or drain air infected by the discharges and the bowel excretions of an enteric fever patient.

To sum up the conclusions to be derived from the arguments adduced: Chemical analysis, aided by microscopic examination, is sufficient in the great majority of cases to determine the amount of organic pollution of a water, and whether it is of recent date. In many cases the source of the pollution, whether from sewage or vegetable matters chiefly, can also be determined; but there is no possibility of ascertaining whether the water thus polluted is actually potent for evil or whether it may not be entirely harmless. Chemical analysis is powerless to deal with those cases of infinitesimal pollution of a pure water with infective material from the human body. Cultivation tests are equally powerless to cope with such cases. The only possible way of ascertaining the probable effects on the human system of drinking such water, is for the operator to perform the experiment on his own person—a course not likely to be pursued. The cultivation tests, as now practised, add very little to the results obtainable by chemical analysis. Micro-biology must undergo further development before germ cultivation methods can be expected to throw much light on water-pollutions. Lastly, the sanitary survey of the source of the water, or its mode of storage, should always be carried out whenever any doubt exists as to the freedom of the water from all possible sources of contamination.

[*This discussion applies to the two preceding papers by* Dr. Percy F. Frankland *and* Dr. Louis Parkes.]

Dr. Alfred Carpenter, (Croydon), who opened the discussion, said it would be very presumptuous on his part to criticise any of the observations which had fallen from the expert chemists who had addressed them. He wished them therefore to look upon him simply as an enquirer endeavouring to elicit some further information. He had heard with a great deal of satisfaction the expressions of Professor Dupré, with regard to the chemical analysis of water supply. He believed more confidently in chemical analysis than did many chemists themselves; for he had yet to learn that any water supply for a considerable district which had been pronounced to be pure and fit to drink by chemists, had ever given rise to an epidemic of typhoid fever. The district of Caterham was alluded to as giving some kind of support to the idea that the water might be pronounced chemically pure, and yet contain the organisms which might spread typhoid fever. He saw a good deal of that epidemic, and he had an impression that if that water had been analysed

by Professor Dupré, for instance, on the day on which it was distributed, he would not have hesitated to pronounce it unfit for distribution. There were circumstances which were not detailed, and which did not come to the knowledge of the enquirers who reported upon the case, and as after it was examined by a local medical man, he did not hesitate to say, "this water has something wrong with it, it could not be truthfully argued, as it was constantly, that the Caterham case was an instance in which the chemist could not detect the presence of disease germs. It was true that by putting half a pint of secretion coming from a patient into a million gallons of water, it was possible that a chemist might not detect it; but he had an idea that if that was done, and it was well mixed up with the water, the condition of that water was such as to draw the tooth of the poisonous matter and render it perfectly harmless, that the germs would abort and would not fructify, even if they retained vitality. He believed that in the waters which Providence provided us with, which were safe, there were measures by which those minute dilutions were deprived of their disease-giving properties. That led him to appear to be the critic of Dr. Frankland. That essayist was speaking of micro-organisms as being themselves poisons, which were the causes of the mischief. He (the speaker) suspected that Dr. Frankland hardly meant what his terms implied; he himself did not consider that micro-organisms were themselves the poisons which had produced the mischief, but they acted upon the organic matter which was in the polluted water; and out of that organic matter they produced the poison which aggregated in the constitution in which the organism was lodged, until it might ultimately be sufficient to destroy life; that was his idea of how the micro-organisms acted as poisons. Just as Simon said five and twenty years ago, they were the tests by which the presence of a poison was made manifest, and he (Dr. Carpenter) had an idea, that when micro-organisms came into contact with water which was comparatively pure, they would abort, and even get completely destroyed; or if they did grow into colonies, such as was shown by the gelatine test, in time they lost their infectious character and did not set up diseases, which at other times they might produce. That might explain some difficulties which had arisen in regard to the *comma* or cholera *bacillus*. Looking at the question from this point of view, it was possible that they might have a *comma-bacillus*, at one time infective, and at another non-infective. He thought that was proved by Dr. Saunderson's experiments, in reference to peritonial inflammations; in the one case the same material was harmless, and in another, by cultivation it became a most virulent poison; whilst apparently it was the same thing. Those were matters regarding which they could not at present draw any dogmatic conclusions, because they were *sub judice*, and had to be followed out much more seriously than they had hitherto been. He thought they might congratulate the Metropolis on the presence of those filtration areas which belonged to the Water Companies, and which were of some service in depriving disease germs of their infective character. The fact that there was at this moment poured

into the Thames the excreta of thousands, and tens of thousands of people; some of whom were labouring under typhoid and other fevers, and that this water was pumped up and supplied to the Metropolis without serious extension of those fevers and other evils consequent upon impure water, was certainly to his mind, due to the filtration so carefully performed by the Water Companies. But he had a sort of idea that whilst the Water Companies by their filtration were arresting the micro-organisms which existed, as active, living, moving micro-organisms, and whilst they were taking out a large portion of the organic matter upon which those micro-organisms lived and propagated their kind, they were still allowing some of those resting spores to which Dr. Frankland had alluded, and which corresponded to the resting spores of the allied tribe of Fungi, pass through the meshes of their filters, and that one of these days when we do get a length of hot weather during the months of July or August, when the water in the mains supplied by the companies rises in temperature above a certain point and remains for a certain length of time above that point, say of 65 F., we should have these resting spores developing into living, moving, growing micro-organisms, capable of feeding on the organic matter which had not been arrested by the filter, and that there would be one of those seasons a rapid and extensive growth of typhoid fever or other fevers in the districts supplied by the Metropolitan companies; and it was a question therefore of the utmost importance, so far as London was concerned, whether those towns above should be compelled to take their sewage out of the river Thames altogether. What he had described would arise one of these times and might possibly lead to panic, and whenever panic did come, it was quite certain to lead to legislation or action on the part of Local Authorities, which would be precipitate, and probably in the wrong direction, whilst its pecuniary effect would be very serious to the ratepayer. Those micro-organisms to which Dr. Frankland made such a startling reference, and which were undoubtedly of the greatest importance, might he thought be altered in their character by the presence or absence of an excess of carbonic acid in the water in which they lived. They might undoubtedly alter in their character according to the fact, as to whether that water were neutral, whether it were acid, or whether it were alkaline. These three conditions would alter micro-organisms in a very important degree, and then the fourth one of temperature came in, and was of the highest importance. Those points required to be sifted out: they wanted information as to the temperature at which the examination was made; they wanted information as to the chemical character of the water; as to the presence or absence of carbonic acid in excess; as to the presence or absence of oxygen; as to the presence or absence of nitrogen; and as to the acidity or alkalinity of the water itself. Until those points were worked out, he did not think they had all the information with regard to the action of micro-organisms upon the water supply, that they would be able to obtain when those points were followed out in the same careful way, as the quantities of the micro-organisms had been studied by Dr. Frankland.

Then the most important and exhaustive paper, so far as it went, of Dr. Parkes, would commend itself to all young men; for he was quite sure they would find in that paper a very large amount of information which should be committed to their memory, and should be studied so that they would be able to see the directions analysis might take in their own districts. In conclusion, he said he had much greater confidence in chemists than they had themselves, and than some persons who were endeavouring to cast suspicion upon chemical analysis. He trusted chemical analysis, and he thought all Corporations should have their water supplies analysed frequently during the year. They should have a local analysis of the water such as Professor Dupré had referred to, and any departure from that habitual state should be carefully enquired into by the Medical Officer of Health and the analysing chemist. Every Water Company ought to have attached to its staff an analysing chemist who should be supplied at irregular intervals with the water ordinarily distributed to the people. This arrangement would afford a great protection to all dependent upon a company or a Corporation for their water supply.

Mr. C. E. De Rance (London) said that the instances where deep well waters had been found to be polluted, were due to want of care on the part of the engineers, who, in constructing the wells, had not jointed the cylinders or lining tubes, or made up the space in the back with concrete, allowing pollution to run down to the water at its source of supply. Special care is requisite in sinking wells in formations which are fissured and jointed, allowing the water to pass through underground channels, whether vertical, or horizontal, without filtering through the rock.

Mr. Pendlebury thought that the method of water analysis which had the greatest future before it, was that of the estimation of the æration of the water. He did not know what method Dr. Dupré recommended. One he had had experience in, was that of the addition of a diluted quantity of known value of sulphuric acid together with a small quantity of sulphate of manganese, which had the remarkable property of bringing about the union of the oxygen dissolved in the water with the sulphurous acid to produce sulphuric acid. After the liquid had been allowed to stand for a time, the residual sulphuric acid was determined with iodine. The pure water from the same district furnished the standard. As to mineral poisons in the water, he did not know whether they knew that Dr. Odex had recently conducted some experiments at Sheffield in regard to the water supply there, some cases of lead poisoning having taken place. He found that although in some instances soft water seemed to have dissolved lead and thus produced lead poisoning, in other apparently similar cases, lead poisoning had not been produced. This latter effect he found to be due to a small quantity of Silica dissolved in the water, and he recommended this course (the solution of Silica in water) to be always adopted with regard to every soft water.

Mr. L. L. Macassey (Belfast) observed that in times past the prevailing opinion had been, that filtration of water through sand made the water brighter in appearance, but without taking out micro-organisms which might be present in the unfiltered water. Water-works engineers had been told by the chemist that their sand filters were practically useless, and this view had been repeated over and over again in the scientific papers of the day. Dr. Frankland had thrown a most important light upon the subject by his recent experiments in Bacteriology. His first paper read last year before the Institution of Civil Engineers, had attracted a good deal of attention, and the present communication supplemented the information thus given in a most important manner. Engineers might now fairly assume that sand filtration was really beneficial in reducing the number of micro-organisms in drinking water. He had himself in certain cases experimented with finely crushed cinders, in part substitution for sand, and had got very good results. A layer of crushed cinders placed between two layers of sand made a most efficient water filter.

Mr. Charles E. Cassal, F.C.S. (London), was glad to hear Dr. Frankland point out the mistake made by people, in supposing that bacteriologists would be able to tell what waters would produce typhoid; what would produce diphtheria; what diarrhœa, and so on. The joy that was felt by a number of people who had no love for chemists as sanatarians, when bacteriology attained its more recent development, knew no bounds. Indeed it was thought by some, that chemists were to be done away with entirely; that water analysis by chemical means was a thing of the past; and that fees might go at last to those who had not had to undergo a severe chemical training. It had, however, been found that the bacteriological results simply furnished an additional "test," and a test quite as uncertain as any chemical test, if not more so. He gathered from Dr. Frankland that the only value of bacteriological methods in regard to water supply, was approval or non-approval of a water according to the number of colonies which he could obtain from it. The paper of Dr. Parkes threw out, as he thought in a very satisfactory way, the view which ought to be taken as to the value of water analysis for sanitary purposes. He had, however, not taken notice of the importance of drawing conclusions from a number of results; there was a tendency to draw conclusions from single results. Some people rode one hobby to death, and it appeared to be a great difficulty to the minds of others to deal with more than one figure at once. Some time ago an analyst proposed the creation of a sort of scale of "marks" to be given to water according to the results yielded by various processes: appearance and colour, chlorides and nitrates, and so on, were to have numerical values assigned to them, put down, added up, and the conclusion drawn from magnitude of sum total at the end. That proposition was extremely unscientific, and his contention was that if analysts would cultivate the habit of drawing conclusions from a number of results, they would never go far wrong. He held it to be most unlikely that a chemist who knew and did his duty, would pass a water as fit

for consumption which was not fit, and he also held that no case in which this had been done could be pointed out. As to the Caterham case, he might point out that he had previously drawn attention to the fact in dealing with the report on that case, that no analyses were made of the water supply at the time of the outbreak.

Professor A. Dupré, F.R.S. (London), said he had been greatly interested in the two papers. He could confirm many of Dr. Frankland's results by experiments of his own made by a different method, the æration method. Pure ærated water remained ærated when kept out of contact with air even for some time; but water containing any living organisms decreased in its degree of æration during keeping. Now unfiltered Thames water greatly decreased in its degree of æration during keeping, whereas the filtered Thames water as supplied to London remained almost completely ærated. Still there were great differences in some cases. When Dr. Frankland applied his test to the Kent water he found a very small number of organisms; but when he (the speaker) applied his test, he found that it diminished greatly in its degree of æration. He was of opinion that further research on the point was necessary, for though they now knew a great deal more than they did formerly, more still remained to be known.

Dr. Louis Parkes (London) thought it would be very difficult to set up local standards of purity for water supply, because they knew that the quality of underground water would vary a good deal according to the season of the year; and they might have a standard which would vary according to the season, and according to the kind of season. Then it would vary according to the geology of different parts of a given district; they might have one half of a village standing on one kind of a geological formation, and the other on an entirely different one. The idea of a local standard of purity was of course an important one, but it required a great deal of working out. With regard to Dr. Frankland's paper, he differed from that gentleman as to the importance of determining the pathogenic micro-organisms in water. It would be a most important thing if they were to be able to point out in the future organisms which they believed were the cause of disease—if they could say "Here is a water which contains a specific disease organism, therefore it is impure." It did not matter very much whether that organism might be present on a future occasion, they had it then and that was sufficient for them. Water was brought to them which was supposed to have caused an epidemic. If they were able to say at once, "We know it has done so because we find the organism in it, which is the cause of that disease;" if they could get to that, it would really solve the whole question. With regard to Thames water, it seemed to him that London depended to a very great degree upon the efficiency of sand filtration. According to Dr. Frankland's researches, if the filtration was carried out properly they obtained a proportionate reduction of the micro-organisms; but

supposing an epidemic of cholera or typhoid were to affect the towns on the upper reaches of the Thames, and supposing that in any case the filtration should fail in any degree, it was possible that the disease germs might pass into the mains of the London companies and so cause disease. That seemed to him the great danger of trusting to an artificial system of filtration.

Percy Frankland, Ph.D., F.C.S. (London), reiterated what he had said about the value of detecting specific germs. He could not admit the great importance of knowing whether this or that water contained disease organisms. What they wanted to know was whether any given water might, under ordinary circumstances, become contaminated with sewage, quite irrespectively of whether the sewage was dangerous or not at any particular time, for it might be dangerous at one time and not at another. It was quite conceivable that water which had occasioned an epidemic might be found not to contain any dangerous organisms in it, for it was obvious that the organisms might have disappeared since the epidemic was occasioned. With regard to filtration, he was not there as an advocate of the methods adopted by the London Water Companies; he was simply there to say what the results of his experiments had been, and he told them that the reduction in the number of organisms was very much greater than might have been expected. Still it was perfectly obvious that it did not prevent the possibility of organisms passing through those filters, although they did not pass through in anything like the number that people would probably have imagined. As to what Professor Dupré had said about the Kent Company's water, the results of his experiments shewed that the water issuing from the water-bearing stratum was exceedingly pure as regarded micro-organisms; but after it had been stored for a few days the number increased with far greater rapidity than anything he had noticed in unfiltered river water. When the Kent water had been kept for some length of time, although multiplication had taken place, they could distinguish between such a sample and a sample of unfiltered river water, by the fact that the number of different varieties of microbes in the unfiltered water was very much greater than was the case in stored deep well water. In the latter case they found they had an almost pure cultivation of one, two, or three organisms, whilst in the case of river water they had not only a large absolute number, but a large variety of organisms. It appeared to him that this phenomenon was explained by the fact that in the river water those different varieties acted as a check one upon the other and so impeded multiplication; whilst in the case of the deep well water, each variety had a freer field. He did not wish the impression to be carried away that any opinion could be formed of the purity of the water from the number of micro-organisms found in it. He had never himself undertaken to determine the number of micro-organisms in water brought in an indiscriminate way. Such a determination he held to be absolutely valueless, because when the water was collected indiscriminately the result would bear no sort of relationship with the result

which would have been obtained if the water had been taken direct from the water-bearing stratum. He wished to add that as regarded purification by filtration, it seemed to him that this biological test was of far greater importance than any chemical test, because everyone would admit that what they desired to remove in filtration were the micro-organisms of various kinds, and by relying solely on chemical analysis very erroneous conclusions had been arrived at as to the value of certain filters. There were filters which produced a remarkable change chemically and yet had little or no effect in removing bacteria, whilst there were other filters which produced absolutely no effect chemically, and yet biologically were so efficient that they removed all micro-organisms from any liquid passed through them. As to the use of cinders, he had no doubt they made a very efficient mechanical filter. Powdered coke was also a valuable filter, as he had previously pointed out.

On "The Air of Buildings and Sewers," by J. S. Haldane.

The subject of my communication is apparently such a wide one, that I fear you may consider that any discussion of it here within reasonable limits cannot fail to be unprofitable. My intention, however, is not to attempt to treat the subject with anything approaching to fulness, but mainly to bring under your notice the results of some experimental researches on vitiated air, recently conducted by Professor Carnelley, of Dundee, and myself,* and to initiate a discussion by the members of the Congress on the conclusions to be drawn from these experiments.

The first series of observations refers to the air of buildings. The fact that an enormously increased mortality prevails amongst persons who spend much of their time crowded together in ill-ventilated rooms is universally admitted. It is therefore unnecessary that I should recapitulate here any of the evidence we possess on this subject, or of that which more directly connects an increased mortality with vitiated air.

* The details of most of the experiments referred to here, will be found in a paper by Prof. Carnelley, Dr. Anderson, and myself, in the Philosophical Transactions of the Royal Society, Vol. 178 (1887), B, and in a further paper by Prof. Carnelley and myself, which appeared in the Proceedings of the Royal Society for June 12th, 1887. The results of the experiments in the Bristol sewers are communicated here for the first time.

One of the first requisites for success in the endeavour to procure pure air is a knowledge of the nature and amount of the various impurities present in vitiated air, and the sources from which they arise. Hitherto our knowledge of the amounts of these impurites has related almost entirely to the carbonic acid and moisture. Carbonic acid is easy to estimate in air, and its amount is rightly assumed to be a pretty good index of the impurities directly communicated to air by respiration. It is, however, highly improbable that carbonic acid itself has any appreciable influence on health in the proportions in which it is ordinarily present in vitiated air. And on the other hand it is a mere assumption, and as we shall see an unjustified assumption, that the carbonic acid is anything like a certain measure of the impurities which are directly or indirectly communicated by human beings to air in other ways than by respiration.

Of the other impurities of vitiated air perhaps most interest attaches in view of recent advances in pathology to the micro-organisms, and especially to the bacteria. It has lately become possible to estimate the latter with relative ease and accuracy, thanks to methods of research introduced by Professor Koch and Dr. Hesse. There are still other impurities, some of which we can detect by the sense of smell. We know little as to their chemical composition, and if possible less as to their hygienic significance. They may be roughly set down as "organic matter." They indicate their presence by several chemical reactions, one of these being the bleaching of solutions of permanganate of potash. For the purposes of our research Dr. Carnelley introduced a process dependent on this reaction, by which the relative amounts of the bleaching action in different specimens of air could be rapidly estimated. (Carnelley and Mackie, Proc. Roy. Soc., Vol. 41, page 238).

Our observations on the air of buildings, relate chiefly to dwellings and schools in Dundee. The main part of our work consisted in making a large number of simultaneous estimations of carbonic acid, "organic matter," and micro-organisms; but we endeavoured in addition to throw what light we could on the sources of each constituent.

The Air of Dwellings.

The analyses of the air of dwellings were made during the night, between the hours of one and five in the morning, as we considered that at this time the air would contain about an average amount of the impurities existing in the air during the presence of the inhabitants. We examined the air in sleeping rooms of 18 of the better class of houses in Dundee, in 13 two-

roomed, and in 29 one-roomed dwellings. The results were as follows :—

	One-roomed houses.				Two-roomed houses.				Houses of four rooms & upwards.			
	No. of Cases.	Lowest.	Highest.	Average	No. of Cases.	Lowest.	Highest.	Average.	No. of Cases.	Lowest.	Highest.	Average.
Persons per house (per room in last class)	29	2	10	6·6	13	4	10	6·8	18	1	3	1·3
Space per person	29	104	528	212	13	148	395	249	18	391	4206	1833
Temperature(°F.)	21	43	61	55	9	50	59	53·5	13	42	63	54·5
Carbonic acid......	29	6·3	32·1	11·2	12	7·1	13·2	9·9	18	4·5	11·7	7·7
Organic matter...	29	7·8	38·1	15·7	11	5·0	30·2	10·1	18	1·1	12·0	4·5
Total micro-organisms :—	28	6·0	240·0	60·0	13	8·0	128·0	46·0	18	0·5	22·0	9·0
Bacteria	19	6·0	120·0	58·0	11	6·0	118·0	43·0	16	0·5	16·0	8·5
Moulds	19	0	5·0	1·2	11	0	10·0	2·2	16	0	1·0	0·4

On each night similar analyses of outside air in the streets were also made for purposes of comparison. If we subtract the amounts found in the air outside from the above quantities, and take the corrected averages for the air of the better class of dwellings as unity, we obtain the following table :—

	Houses of four rooms and upwards.	Two-roomed houses.	One-roomed houses.
Cubic space per person	1	0·13	0·11
Carbonic acid	1	1·5	2·0
Organic matter	1	1·6	4·4
Micro-organisms (total)	1	5·1	6·7
Bacteria	1	5·1	6·9
Moulds	1	5·5	3·0

These tables show clearly the enormous differences in the purity of the air of different classes of dwellings.

Dr. Anderson, Medical Officer of Health for Dundee, with whom we were associated in our work, and who originally suggested it, obtained by special arrangements with the registrars materials which made it possible to construct a table of the mortality statistics of Dundee for 1884, arranged in a similar manner.

		No. of Cases.	Per 1,000 living. Whole Population	Houses. 4-roomed and upwards.	3-roomed.	2-roomed.	1-roomed.	1 & 2-roomed, including Infirmary and Poorhouses.
Death-rate.	General death-rate	3119	20·7	12·3	17·2	18·8	21·4	23·3
	Death-rate of children under 5 years of age	1347	9·0	3·3	5·8	9·8	12·3	10·8
	Ditto of all above 5 years of age	1772	11·7	9·0	11·4	9·0	9·1	12·5
	Ditto of all above 20 „ ...	1419	9·4	8·2	8·9	7·3	8·5	9·8
	Ditto of all above 70 „ ...	293	1·9	2·4	2·1	1·4	1·3	1·4
	Ditto of all above 80 „ ...	75	0·5	0·65	0·77	0·39	0·20	0·41
Mean age at death.	Of all who died........................	3119	24·5	40·0	30·6	21·3	20·9	23·9
	Of all who died above 70 years...	293	76·3	76·9	77·2	76·9	74·6	76·0
	Of all who died above 20 „ ...	1419	53·6	57·7	54·4	51·6	54·8	52·1
	Of all who died below 20 „ ...	1619	2·5	4·5	4·4	2·2	1·8	2·3
	Of all who died above 5 „ ...	1732	45·2	51·7	45·5	43·0	48·2	44·1
	Of all who died below 5 „ ...	1306	1·1	1·4	1·2	1·1	0·9	1·0
	Of all who died between 5 and 20 years	313	9·2	11·7	12·2	8·3	7·0	8·3

				Per 10,000 living.					
Diseases causing more than 50 deaths.		Deaths from under-mentioned causes:—							
	A	Diarrhœa	253	16·9	6·1	11·3	17·4	26·4	20·2
		Measles	94	6·3	1·3	3·6	7·0	9·1	7·9
		Convulsions	78	5·2	1·7	2·3	6·5	6·7	6·6
		Accidents (including over-laying)	93	6·2	1·7	1·8	3·4	14·6	8·3
		Premature birth and debility during first days of life ...	177	11·8	3·0	6·3	13·4	17·0	14·8
		Acute bronchitis & broncho-pneumonia......................	224	14·9	7·8	9·5	13·4	26·7	17·6
	B	Chronic bronchitis	159	10·6	6·3	9·5	8·1	16·5	11·8
		Croupous pneumonia	155	10·3	3·5	6·6	12·7	9·5	12·5
		Meningitis........................	122	8·1	5·7	6·8	8·9	6·7	8·9
		Hooping-cough	99	6·5	0·9	6·8	8·3	6·3	7·8
		Tumours	73	4·2	2·2	3·6	4·1	3·1	5·7
		Heart (valvular) disease......	159	10·6	9·1	9·5	8·4	9·4	11·1
	C	Phthisis	369	24·6	13·0	27·6	24·4	14·6	26·4
		Apoplexy, thrombosis, & embolism of vessels of brain..	160	10·7	17·4	5·9	6·9	7·9	10·2
		Diphtheria and croup	93	6·2	7·0	4·1	6·9	3·1	6·5
		"Old age"	150	10·0	8·7	12·7	5·5	7·5	9·7

I have not time to say anything further here with regard to this table, but I think it has many points of interest of its own quite apart from our experimental results. It shows that not only is the mean age at death on the whole about twice as long

in the best as in the worst houses, but that at all periods of life up to old age those who live in the better houses have the advantage.

The fact that the increase in death-rate runs parallel with the increase in air-pollution does not prove that the former is the cause of the latter. But we may argue from other evidence, such as that so ably presented by Dr. Ransome in his lecture last night, that the pollution of the air is one very potent cause, and probably the chief cause, of the increased mortality.

The Air of Schools.

We examined during winter at least two rooms in each of the Board schools and several denominational and private schools in Dundee, besides several lecture-rooms in University College. The rooms examined may be classified in the first place according to the means of ventilation, as this was found to make an enormous difference in the results. A certain proportion were ventilated by ordinary means, such as fires, open windows, and ventilators in the roof. The rest were ventilated mechanically by blowing air by means of fans over hot pipes, and thence into the several rooms by means of shafts. The following table gives the results obtained with the two kinds of ventilation :—

	Schools.							
	Naturally ventilated.				Mechanically ventilated.			
	No. of cases.	Lowest.	Highest.	Average.	Average.	Lowest.	Highest.	No. of cases.
Per cent. of windows open..	...	...	...	22	3	...	...	...
No. present, including staff.	39	27	191	92	64	20	170	20
Space per person...............	39	56	427	168	164	119	228	20
Temperature (°Fahr.)	35	44	65	55·6	62	58	69	18
Carbonic acid	39	7·9	37·8	18·6	12·3	7·0	19·6	20
Organic matter	38	5·0	40·3	16·2	10·1	3·4	19·0	20
Total micro-organisms:—...	35	8	600	152	16·58	0	58	18
Bacteria.....................	28	8	600	151	16·0	0	56	18
Moulds	28	0	4	1·1	0·58	0	2	18
Or above outside air :—								
Temperature (°Fahr.)......	25	3	34	16·8	24	22	26	3
Carbonic acid	39	4·4	34·3	15·1	8·9	3·5	16·1	20
Organic matter	38	0	31·4	7·8	1·1	0	5·3	20

Or, if we take as units the average cubic space, the average excess over outside air of temperature, of carbonic acid, of organic matter, and of micro-organisms, in mechanically ventilated schools, the comparative results for naturally ventilated schools may be expressed as in the following table:—

	Mechanically ventilated.	Naturally ventilated.
Cubic space per person	1	1·0
Temperature in excess of outside air	1	0·66
Carbonic acid ,, ,, ...	1	1·7
Organic matter ,, ,, ...	1	7·0
Micro-organisms ,, ,, ...	1	9·2
Bacteria ,, ,, ...	1	9·4
Moulds ,, ,, ...	1	2·0

We have not included in the above table the Dundee High School, nor the only private school we have examined, as in these two cases the cubic space per person was about three times as great as in the other schools. The results for these two schools were as follows.—It will be seen that practically they confirm the conclusions drawn from the results in other schools, though the effects of mechanical ventilation are not nearly so marked :—

	Private School (Girls) Naturally ventilated.				Dundee High School (Boys and Girls) Mechanically ventilated.			
	No. of rooms examined.	Lowest.	Highest.	Average.	Average.	Lowest.	Highest.	No. of rooms examined.
Numbers present	3	6	11	9	36	13	64	6
Space per person	3	320	528	457	538	320	1102	6
Temperature (°F.) ...	3	56	57	57	57	51·5	60·5	6
Carbonic acid...........	3	10·7	13·3	11·9	13·0	8·5	16·4	6
Organic matter	3	6·2	11·8	8·9	3·9	1·7	5·6	6
Total micro-organisms	3	4	15	9·3	3·6	1	11	7

We now come to some of the most unexpected and interesting of our results. Wishing to test more thoroughly the results of mechanical ventilation, we made a number of comparative experiments on different days in the same room. The circumstances were as nearly as possible the same, except that on some days the mechanical ventilation was in operation, and on other

days not, open windows, &c., being used instead. We found, to our surprise, that whereas the carbonic acid present in the air was increased from 12·6 to 18·6 volumes with the mechanical ventilation not in operation, the average number of micro-organisms remained almost exactly the same. Even when the mechanical ventilation was kept off for a week this had no distinct effect in increasing the number of micro-organisms. These anomalous results did not lead us to doubt the effects of mechanical ventilation in diminishing the number of micro-organisms in air, as we found the number very small even in rooms where every other condition except the ventilation seemed to favour a large number. We were, therefore, forced to conclude that while the ventilation at the time is the decisive factor in influencing the amount of the gaseous impurities, it is, other things being equal, the habitual state of the ventilation which influences the micro-organisms. This led us to inquire into a number of points regarding the sources of the micro-organisms.

It had previously been proved by Tyndall and others, that physical disturbances of any kind, such as those caused by the presence of human beings, have a great effect in disseminating micro-organisms in air, and that air left perfectly still gradually deposits its micro-organisms. We naturally, at first, expected that varying amounts of physical disturbance would very much obscure other differences. It turned out, however, that this is not the case. Although the influence of difference in physical disturbance is well marked, under ordinary circumstances other influences have a much greater effect, as we shall see.

That the micro-organisms do not come from the breath, but are on the contrary filtered off by respiration, we showed by means of some experiments, the details of which need not be described here (see Phil. Trans., vol. 178, B, page 92). That they do not come in any large number directly from the clothes or skin of the persons present in a room was shown by a number of observations made in the two chemical lecture rooms. Even during a course of crowded popular lectures there was found to be an average of only four micro-organisms per litre, as compared with an average of about three when the room had remained empty. Nor did the number rise beyond six per litre when the room was left unventilated during the lecture, and the carbonic acid rose to nearly 40 volumes per 10,000. This observation alone shows strikingly, I think, that the carbonic acid is no measure of the number of micro-organisms in the air of a room.

The micro-organisms thus do not come to any large extent from the bodies of the persons present at the time. Nor do they come from the outside air, which is comparatively free from micro-organisms during winter, as shown both by our own

experiments and by the more recent and systematic ones of Dr. Percy Frankland. We must therefore conclude that they come from the floor and other parts of the room itself. If this is really so, the state of a room as regards cleanliness ought to have an effect on the number of micro-organisms. This we found to be actually the case, as shown in the following classification of both schools and houses:—

		No. of cases.	Average space per person.	Average carbonic acid.	Average organic matter.	Average micro-organisms.
One-roomed houses	Clean	1	295	8·0	13·1	18
	Dirty	7	200	9·9	18·1	41
	Dirtier	13	221	10·7	13·5	49
	Very dirty	6	220	11·0	15·1	93
Two-roomed houses	Very clean	2	273	12·2	10·8	10
	Clean	4	264	9·3	7·7	22
	Dirty	7	233	9·4	11·2	69
Naturally ventilated Board schools	Cleaner	12	167	19·7	18·1	91
	Average cleanliness	12	166	14·2	16·2	125
	Dirtier	12	191	22·5	15·2	198
Mechanically ventilated schools and college	Cleanest	7	194	12·5	12·7	3
	Clean	11	155	12·8	8·3	16
	Less clean	4	152	10·8	9·8	30

We next classified the schools according to age, and obtained the following results:—

	No. of cases.	Micro-organisms per litre.
Opened before 1866	7	311
,, 1875—1880	20	150
,, 1884—1885	5	38

This was not at all what we expected to find. One would rather have anticipated that the micro-organisms, like the ordinary dust particles in a room, would very soon reach a maximum, depending on how often the room was cleaned. But the causes under the action of which a room becomes infested with micro-organisms are evidently no merely temporary ones, but have a gradually cumulative action. Further investigations on this point are now being carried out by Professor Carnelley at Dundee.

At the time when the results of our analysis led us to this important result, we were unaware of a very interesting research made recently by Dr. Emmerich of Leipzig; I think the results he obtained may throw a great deal of light on this cumulative infection of the air by micro-organisms. At any rate his research was such an important one, that I need not apologise for shortly referring to it.

He made a large number of analyses of the damping material used for filling up the space between the ceiling of one flat, and the floor of the flat above. He found an almost incredible pollution of this material. His analyses show that, to use his own words, "there exists nowhere in nature, not even in the neighbourhood of human dwellings, a soil so highly contaminated with nitrogenous organic substances and their decomposition products as the damping material under the floor of dwelling rooms." The amount of chloride of sodium found in this material was on an average seven times greater than that found in the ground under leaky cesspools, and twelve times greater than that in the soil round a dung hill, although this soil was visibly soaked with filth. When the coarse pieces of stone were separated from this material, it was found that the finer dust and sand which was left, contained even more nitrogenous matter than human excrement. "In the damping material of a single room, there was usually more excremental matter present than in a large cesspool." That all this filth is alive with micro-organisms, is shown by the amount of the products of decomposition which result from their activity. Thus under the floor of one single room Emmerich found that there were more than 6 cwt. of nitric acid in the form of nitrates. He also showed that the carbonic acid in the air of rooms left shut up and empty increased, although all other known sources of carbonic acid, such as sub-soil air, &c., were excluded. The chief cause of this contamination was undoubtedly the soaking of fluids and shaking of dust through the fissures and spaces between the boards in the floor. Often, however, the rubbish which was used as damping material was contaminated from the beginning, having been taken from old houses, or rubbish heaps, such apparently as many houses in this country are built upon.

Emmerich's paper is such a remarkable one, and contains so many points of interest, that one is surprised at not having heard something of it in this country. It is well worth the careful attention of everyone interested in questions of public health. There seems no reason to doubt that a very similar state of pollution exists in the damping material of English houses. A few days ago I obtained a specimen of this material from an

old house in Edinburgh. One could see at a glance that it was highly polluted with organic matter, and the part which past through a coarse meshed wire sieve was found to lose about a third of its dry weight on ignition, giving off at the same time a most offensive smell. I am told by Mr. Krunear, of the Dundee Sanitary Department, that houses are sometimes made uninhabitable merely by the smell of this material, which in these cases has to be removed.

Emmerich followed up this research by another no less interesting one in connection with the same subject. In a prison at Amberg there had persistently occurred for years epidemics of croupous pneumonia. The last of these had attacked every seventh, and killed every twentieth prisoner. As is well known, the late Dr. Friedländer of Berlin discovered the presence in cases of croupous pneumonia of a species of bacterium, cultivations of which, when inhaled by, or inoculated into certain animals, produces a similar disease in them. There can thus be little doubt as to the causal connection between this organism and the disease, or at any rate certain forms of it. Emmerich examined the damping material from the infected rooms in the Amberg prison. He not only found this material full of organic matter as usual, but actually discovered Friedländer's bacterium in enormous numbers.

To return to our own researches, it seems very likely that the progressive contamination of the material in the floors, and perhaps elsewhere about the room, may be connected with the progressive contamination of the air with micro-organisms. Emmerich's researches throw a vivid light on the manner in which this progressive contamination may affect the health of the inhabitants. A glance at our table of statistics will show how the mortality from croupous pneumonia, for instance, increases from 3·5 per thousand in the better houses to 6·6 in the three-roomed, and 12·5 in the one and two-roomed. Probably the mortality would be even larger in the latter class were it not for the influence of hospital treatment, which is very frequently taken advantage of in cases of croupous pneumonia, and is of great benefit.

In what manner exactly mechanical ventilation reduces the number of micro-organisms in the air seems still rather obscure. The explanation may perhaps lie in the more efficient sweeping out with the air of the particles of suspended organic matter which would otherwise have formed a pabulum for the growth of micro-organisms. Or perhaps the growth of the latter may be prevented by the greater dryness of the rooms mechanically ventilated.

Let me refer to one or two further points before leaving the

subject of school ventilation. We classified the schools according to the cubic space per child at the time of our visit. It will be seen that increased cubic space up to 300 cubic feet brought with it no diminution in the pollution of the air. With mechanical ventilation, on the other hand, there was a diminution, at any rate in the number of micro-organisms, with increase of cubic space.

Cubic space per person.	Naturally ventilated.				Mechanically ventilated.			
	No. of Cases.	Carbonic Acid.	Organic matter.	Total micro-organisms.	No. of Cases.	Carbonic Acid.	Organic matter.	Total micro-organisms.
Cubic feet. 50—100	6	21·5	16·2	119				
100—150	14	15·5	19·6	128	7	14·0	7·8	23
150—200	5	18·9	12·3	150	8	11·4	9·6	14
200—250	9	21·1	16·8	188	5	11·8	12·3	10
250—300	4	17·1	9·5	187				
300 and upwards .	4*	15·1	11·8	12	6	13·0	3·7	2

We also divided the naturally ventilated schools we examined into two classes, according as they were heated and ventilated by fires or by hot pipes respectively: and we obtained the following results. The data for mechanically-ventilated schools are added for comparison:—

Description of School.	No. of rooms examined.	Carbonic acid.	Organic matter.	Total micro-organisms.
Ventilated mechanically, and heated by hot air blown into the rooms ..	20	12·3	10·1	16·5
Heated by fires, and ventilated in the ordinary way	18	16·9	15·7	169·0
Heated by hot pipes in the room itself, and ventilated by windows, ventilators in the room, and in some cases by a few small TOBIN'S tubes ..	21	20·0	16·5	92·0

* Three of these were in a Private School.

The following table shows the result of a comparison of a number of pairs of rooms. The rooms in each pair were as similar as possible in every respect (such as age of children, &c.) except that one was occupied by girls and the other by boys :—

	Space per person.	Temperature. (° Fahr.)	Carbonic acid.	Organic matter.	Micro-organisms.
No. of rooms compared	30	20	20	16	30
Boys	275	60	15·0	7·9	92
Girls	382	58	12·3	6·7	65

The general result of our investigations has, I think, revealed a state of matters in schools urgently calling for improvement. The amount of loss of life and health resulting from the vitiated state of air is in all probability enormous. Captain Douglas Galton dealt with this subject in his admirable inaugural address at the Newcastle Congress of this Institute. Let me only recall one of the facts mentioned by him : that the mortality among teachers in elementary schools was found to be about 20 per 1000, as compared with 5 per 1000 in two classes where the average age was presumably about the same—the police and navy—and 3 per 1000 amongst prisoners.

We can afford to provide abundance of fresh air for criminals, and surely we might do as much for our children. It is not only abundance of ventilation that is required for keeping the air of rooms pure, but the room itself must be prevented from becoming contaminated with dirt. For this both personal cleanliness is required, and the means of keeping the room itself and everything underneath and about it absolutely clean. I do not doubt that engineers and architects can devise not only satisfactory and sufficient methods of ventilating and warming schools, but also floors which will be incapable of becoming polluted in the manner just referred to.

The Air of Sewers.

The analyses we have made of sewer air refer chiefly to sewers at Dundee and at Westminster Palace. We used exactly the same methods as had been used for houses. Altogether we examined thirty-two specimens of sewer air at

different times and places. The average results obtained at Dundee and Westminster are shown in the following table:—

	Total.				In excess of outside air at time.			
	Temp. F.	Vols. carbonic acid per 10,000 vols. of air.	Vols. oxygen to oxidize the organic matter in 1,000,000 vols. of air.	No. of micro-organisms per litre.	Temp. F.	Vols. carbonic acid per 10,000 vols. of air.	Vols. of oxygen to oxidize the organic matter in 1,000,000 vols. of air.	No. of micro-organisms per litre.
April 19th to May 19th, 1886.								
In sewers	54°	7·5	7·2	8·9	5·2°	3·8	4·9	—7
Outside air at same time	49	3·7	2·2	15·9	...	...	...	...

If we compare these results with those obtained in schools and dwellings, an astonishing difference appears in favour of the sewers. This is brought out more clearly in the following table, in which the average quantity in excess of outside air of each constituent in sewer air is taken as unity :—

		Carbonic acid.	Organic matter.	Micro-organisms.*
Sewers	....	1	1	1
Houses	one-roomed	1·7	1·3	$7x$
	two-roomed	1·4	0·45	$5x$
	four rooms & upwards	0·9	0·3	x
Schools	naturally ventilated .	4·0	1·6	$17x$
	mechanically ,, .	2·3	0·2	$2x$

Evidently in some respects sewer air is one of the most free from micro-organisms anywhere in a town. It is in this respect twice as pure as outside air, in summer at any rate. This result may perhaps come as a surprise to many people, but is in reality not in the least surprising. Professor Nägeli of Munich showed some years ago that micro-organisms, like other particulate matter, are not given off from moist surfaces. As everything inside a sewer is moist we should therefore not expect micro-

* In this case we have represented the relation of the number for sewer air to that for air in four-roomed houses by x, as the calculated number for sewer air is negative. The real value of x must be between $\frac{9}{7}=1·3$, and infinity.

organisms to be given off. That even the motion of water running as in a sewer does not give off anything particulate was also shown by some interesting experiments with lithia solution published by Professor Frankland in 1877.

We may contrast the obstacles which thus exist to micro-organisms being given off by sewers, with the absence of such obstacles in the case of accumulations of dirt about or underneath the floor of a room. The latter accumulations are more or less dry, and constantly being shaken, and the air of the floor is usually being sucked up into the room. There are thus all the conditions present for air contamination. How easily such contamination may arise is shown by the fact that a slight shake of the bottle containing the specimen of damping material referred to above, was sufficient to cause a distinct cloud of dust to rise.

What now are the sources of the few micro-organisms actually found to be present in sewer air? Professor Frankland showed that the bursting of bubbles disseminated particles of lithia solution, and therefore presumably micro-organisms. We made some laboratory experiments at Dundee, which showed directly how completely Professor Frankland's inference was justified. But in the sewers we visited there was no bursting of bubbles, as the current was far too fast for sufficient putrefaction to take place; it therefore seemed desirable to ascertain whether the micro-organisms had not simply come in by the ventilators from outside. It was not so easy as might have been supposed to get conclusive evidence on this point; but I think we can show that it is at least exceedingly probable that this was the source of almost all the micro-organisms.

In the first place if the micro-organisms came from any part of the sewer or its contents, we should expect that the longer the air remained in the sewer, the more would it become charged with micro-organisms. It is usually difficult to discover from direct observations how long in any particular case air has remained in the sewer, but we can judge roughly of this from the amount of carbonic acid present. If we classify the results in three equal divisions, according to the amount of carbonic acid found, we obtain the following table:—

Total:—	Temperature.	Carbonic acid.	Organic matter.	Micro-organisms.
4·9—6·2 vols. carbonic acid	55·8°	5·7	5·1	8·7
6·7—7·9 „ „ „	53·1	7·3	6·3	6·4
8·6—10·9 „ „ „	53·0	9·4	10·5	5·4

It will be seen that as the carbonic acid increases, the micro-organisms decrease in number. A similar result is obtained by classifying according to the strength of the draught:—

	Carbonic acid.	Organic matter.	Micro-organisms.	In excess of outside air. Carbonic acid.	In excess of outside air. Organic matter.	In excess of outside air. Micro-organisms.
Strong draught	6·6	5·7	9·9	2·6	3·5	— 2·3
Moderate draught	7·5	8·8	8·9	3·9	6·6	— 9·2
Little or no draught ..	9·4	8·1	6·7	6·0	5·5	—14·3

Again, we analysed the air in the main Westminster Palace sewer, before and after certain improvements in the ventilation had been made. After the improvement there was a much stronger air current along the sewer. It will be seen that while the amounts of carbonic acid and organic matter were diminished by the improved ventilation, the micro-organisms increased in number.

	Carbonic Acid.	Organic matter.	Micro-organisms.
Average before improvement	7·8	11·0	7
Average after improvement	6·2	2·7	10·3

In order to investigate this point further, it was evidently desirable to examine air in a sewer as much as possible cut off from outside air. As is well known, the Bristol sewers are as completely as practicable shut off from outside air. I therefore applied a few weeks ago for permission to examine them. Dr. Davies, Medical Officer of Health, and Mr. Ashmead, C.E., kindly gave me every possible facility for my work.

The Bristol sewers can only be entered, without digging, at two places, each of these being close to the outlet of the sewer. At only one of these outlets (the one a short way below the Clifton Suspension Bridge) were the conditions favourable for the experiment. In this case there was a draught down the sewer towards the man-hole. This air must have come a long distance in the sewer, as there were no inlets anywhere near. It was found that the number of micro-organisms at this point was exceptionally small, the average of two analyses giving only two per litre. The result thus entirely confirmed our

hypothesis. At the other outlet, the temperature in the sewer was so high that when we opened the trap-door there was a double draught in the man-hole, the hot air of the sewer rising, and cold air rushing down and along the sewer. Hence the sewer air became mixed to a certain extent with outside air. As was to be expected, therefore, the sewer air was not in this case so free from micro-organisms. A short way up this sewer there were found in each of two analyses 8·5 micro-organisms per litre, whereas the outside air at the mouth of the man-hole contained 13 per litre.

There was hardly any smell perceptible on entering or leaving the Bristol sewers. The carbonic acid near the Clifton outlet amounted to only 19·7 and 20·7 volumes per 10,000 in two analyses, while the amount was much less (14·1 and 9·1 volumes) near the other outlet. This amount is of course very small, less than what was found in many schools. If we consider that the subsoil air at the depth of the sewer probably contained more than ten times as much carbonic acid, the result is rather surprising. There was a rapid flow along these sewers, so that no time was given for putrefactive changes in the sewage.

An interesting point in the Bristol experiments was that the number of moulds in the sewer air was found on an average to equal that of the bacteria, whereas in the air of the streets in summer weather the bacteria found far exceed the moulds as a rule. Now it has been shown by Hesse that moulds, although their spores are much larger than bacteria, nevertheless remain suspended in the air much more readily. Hence we expressed in a previous paper the anticipation that on the hypothesis that the sewer micro-organisms come from the outside, the proportion of moulds would be found to increase in proportion to the decrease in the ventilation. The Bristol experiments thus bear out the hypothesis.

The point is well illustrated by the results of some experiments made with a long piece of wide tubing arranged to represent the sewer, and with a draught through it of about a foot per second. The micro-organisms were estimated simultaneously at the two ends of the tube. The air passed along the tube was very rich in micro-organisms. As the average of two experiments with this arrangement we found that while there were 225 bacteria to 57 moulds at the mouth of the tube, there were only 100 bacteria to 57 moulds at the other end. Thus the bacteria had diminished by half while passing along the tube, whereas the moulds had not diminished at all.

I think there is thus a strong case, from the sewer point of view, against outside air. It is evidently, as a rule, the outside air which contaminates the sewer air with micro-organisms, and not

the other way. Nevertheless, in one respect we obtained clear evidence of contamination by micro-organisms arising from the sewer itself. In two cases where there was splashing in a sewer from pipes entering in the roof, we found that the air close to the splashing contained 103 and 25 micro-organisms per litre; whereas the air a few feet away, and after the splashing had ceased, contained only 12 and 8 micro-organisms. Some experiments with the artificial sewer showed that large numbers may be disseminated in this way. Air, in a litre of which no micro-organisms were found before splashing caused by pouring a putrefying infusion from a height, was found to contain several hundreds per litre during the splashing. Splashing in a sewer should therefore be avoided if possible.

The results of these researches will perhaps tend to mitigate some of the terror with which we have come to regard sewer air. Sewer air has commonly been supposed to be "loaded" with micro-organisms, whereas, in reality, it turns out to be some of the freest air from micro-organisms that can be found. It may be answered that it is not a matter of quantity, but of quality. There may be very few germs, but they may be very deadly ones. Doubtless they may be, but until we have definite reasons for supposing that this is the case, the presumption is, that they are no more harmful than other germs which are floating about everywhere.

What is the supposed evidence for the causation of typhoid fever and other diseases by the inhalation of sewer air? We may dismiss at once as absolutely worthless by themselves collections of cases in which something has been found wrong with the drains in a house where a case of typhoid fever has occurred, or where the patient has been found to have sniffed at a sewer grating or ventilating pipe shortly before his illness. What one would require to know is whether the proportion of cases occurring among those most exposed to sewer emanations is greater than among those less exposed. Without evidence on this point, isolated cases prove absolutely nothing, considering how constantly most persons are exposed to a greater or less extent. Let me recall some of my own experiences in this respect during the last few months. I do not suppose there is anything exceptional in them. During the recent hot weather, I could seldom go along the streets of Oxford without being unpleasantly reminded of the sewers at very frequent intervals. During last autumn I worked all day for many weeks in a laboratory in Berlin, where one or other of the traps connected with the sinks was forced every few minutes, this sometimes causing an offensive smell; and I can recall various other ways in which I have been more or less constantly exposed to emanations from sewers or drains. I may add that

we never felt the slightest ill effects from working in the sewers, although on some days we spent several hours in them.

But apart from individual cases of typhoid, there are various records of groups of cases having occurred in houses where something was wrong with the drains. Some of the most noteworthy are contained in Dr. Murchison's famous book on Continued Fevers. On looking through these records, one finds again and again that the reason why these outbreaks were traced to emanations from sewers and cesspools was simply that no other cause could be discovered at the time. When one considers that nothing is more common than for groups of people to be exposed in a similar way without typhoid fever occurring, it seems to me that, so far as the evidence goes, one might quite as well trace the fever to the influence of almost any other local cause. What is required to make such instances of the slightest value is satisfactory negative as well as positive evidence. Such apparent negative evidence as is offered is usually entirely illusory. The fact, for instance, that an epidemic stopped after some drainage defect was altered, proves nothing at all, because, judging from experience in other cases, the epidemic would have ceased at any rate. Nor does the fact that epidemics are sometimes localised in buildings round some source of drainage emanations prove anything without corresponding negative evidence. Systematic observations carried on for years in the Munich barracks, and reported by Dr. Port, showed that groups of cases often occurred at some particular part of the barracks. Sometimes these cases occurred close to the privies, but they showed no special tendency to occur in these parts of the buildings. As regards sewer air in particular, let me once again recall the fact shown by Buchanan for English towns, and abundantly confirmed by more recent German statistics, that the introduction of sewers to towns has been almost universally followed by a diminution in the amount of typhoid.

I cannot now enter further into this controversy. I have argued that the belief in the connection of sewer air with typhoid fever rests not on satisfactory evidence, but largely on *a priori* reasoning. Our observations on the impurities of sewer air would have no weight against any satisfactory evidence for the connection between sewer air and fevers; but I think they have very great weight against the *a priori* reasoning on which I have tried to show that the sewer air theory largely depends.

When I say this, I do not wish it to be supposed that I am arguing that emanations from drains are in every way harmless. It seems to me highly probable that a house, the air of which is contaminated in this way, is unhealthy, as well as, and perhaps

simply because it is, unpleasant. The organic and other substances contained in such air may, from their unpleasant smell or otherwise, have a very serious effect on health. In any case I feel confident that the attention which has been given to the means of preventing such contamination is well worth the trouble. But in the present negative state of our knowledge on the subject we should cease to attribute blindly to sewage emanations cases of disease of which we do not know the cause, and patiently seek for convincing evidence as to the real causes; whether these lie in sewage emanations or floor-damping materials, or in the subsoil, or the water supply, or elsewhere.

August Dupré, Ph.D., F.C.S., F.R.S. (London), said the paper was a very valuable one and exhibited a vast amount of research, although it was rather startling in some of the conclusions drawn. Though the writer had seemed to be very cautious in what he said, he (Professor Dupré) could not help thinking he had rather exaggerated some parts of his case. Dr. Emmerich's conclusions were not by any means generally accepted in Germany by men of science.

Dr. Louis Parkes (London) thought the Sanitary Institute ought not to allow the paper to pass without a few words of caution to the public as to the character of the atmosphere in sewers. The method pursued in this case rather showed them what micro-organisms they could find than what were really present. There might be hundreds, thousands, aye, millions of organisms which could not grow in peptone gelatine at ordinary temperatures under ordinary conditions. From what they knew of the state of research in this country it followed that those experiments must be taken with great limitations; they told them what they could find out, but they told them nothing of the boundless organisms which were not capable of being recognised by that process. They all knew that micro-organisms were not given off by wet surfaces, they were found on dry surfaces, and yet they all preferred to live on a dry rather than on a damp soil. If they were to accept the teachings of Mr. Haldane's paper, they would have to put aside all the teachings of sanitary science and all past experience as to the spread of disease and fevers. The accumulated evidence on this point was now very strong, and the facts that had been brought forward in the paper did not really controvert any of the evidence as to the dangers of inhaling sewer gas. What had been said about micro-organisms might be just as stated; but that was no reason why they should cease to endeavour to keep sewer air from entering their houses. Let them not go away with the idea

that sewer air was purer than the external atmosphere, and therefore better to breathe. If they did, the logical conclusion must be that they had better pass their lives in the sewers.

Mr. Johnson Martin (Bolton) suggested that the increased number of micro-organisms found when fresh air was admitted to the sewers might arise from the increased rapidity of the air current, which carried more of the organisms into a given space. He had met with many cases of fever himself where there was absolutely no other cause except sewage emanations to which the outbreak could be attributed, and it would be a most dangerous thing for it to get abroad that sewage emanations were not dangerous to health and ought not to be guarded against. The statement made by Mr. Haldane was simply one of theory.

Prof. Carnelley (Dundee) said that all they wished to emphasise was that the proofs which had been advanced in support of the supposition that sewer air produced typhoid and infectious diseases, were not conclusive. They did not say it was harmless, nor did they wish anyone to breathe sewer air; they simply wished to get at the facts of the case. It did not always follow that because a case of typhoid could be traced to no other source than sewer gas, that it was therefore true that sewer gas was the cause. The case mentioned by Mr. S. W. North in the sitting of the Congress the other day, was a case in point. Mr. North mentioned that they had 130 cases of typhoid in York, and that 120 of them were traced conclusively to the milk supply. But Mr. North had plainly stated, that had it not been for that fact being brought to light by notification, he should have set it down to some defect in the sewers. As to "damping" material, he did not think it was generally used in this part of the country, but it was extensively used in Scotch towns, in the space between the ceiling and the floor, and it was thus used so as to deaden the sound. There were cases where this space was entirely filled up by cinders, which appeared to have been ashpit refuse, and which might therefore be contaminated to a dangerous degree. So that when the floors were washed, and the rooms became warm in the natural order of things, there were all the conditions necessary to the gross multiplication of disease-producing organisms; and he had no doubt that many cases of disease which had been put down to the effect of sewer gas, had really been due to that "damping" material, which was especially harmful in rooms used as nurseries, where there were usually other conditions likely to contribute to the fermentation of the filth below. As to the effects of cleanliness, they had been making some experiments in schools in Dundee; they thought it must be very good if schools could be washed a great deal oftener than at present. At Dundee they were only washed two or three times in the course of a year. They therefore chose two schoolrooms which were as nearly as possible alike as regarded cubic space per child, and as to the condition of the children attending. The air of these two rooms was analysed every

other day for a fortnight, one being washed at regular intervals, and the other left as before. The result was very curious; whilst the number of micro-organisms in the air of the unwashed room kept up to one average, those in the washed room first decreased after washing to 31, and then increased to 147, and finally settled down to 106; whereas the average before washing had been 112. The above results are difficult to explain; the experiments, however, are as yet far from complete, and no doubt the true solution of the problem will be forthcoming, when the conditions have been thoroughly investigated. In the meantime, there cannot be the slightest doubt, as other experiments have conclusively shown, that cleanliness has a very material effect in diminishing the number of micro-organisms present in the air of buildings.

August Dupré, Ph.D., F.C.S., F.R.S. (London), here said Mr. Chadwick had sent a letter to the sitting which was too long to read, but which stated that the statistics he had collected bore out the experiments related in the paper.

On "*Notes on Lancashire Water Supply*," by C. E. De Rance, Assoc.Inst.C.E., F.G.S., F.R.G.S. Secretary of the Underground Water Committee of the British Association.

An ordinary geological map of the county of Lancaster, gives but little clue to the conditions which induced the early settlers in the county to locate themselves in the spots now covered by almost countless towns and villages. The site of original habitation is nearly invariably on a knoll or patch of sand and gravel, forming a portion of the Glacial Drift, which covers the plains of Lancashire, and sweeps far up into the deep valleys covering the older rocks like a mantle, so that they are only seen at intervals where the rivers have cut down deep, and the denuded edges of the strata are seen beneath the Drift. So much so is this the case, that no sections of the older rocks occur on the coast of Lancashire from the mouth of the Mersey at Liverpool, to Heysham Point in Morecambe Bay; and again northwards the Drift is still seen forming the cliffs at Hest Bank, and westward at Rampside, near Barrow. At Blackpool the cliffs of Boulder Clay and Sand rise to a height of more than 100 feet; and the valleys of the Ribble, at Preston,

and the Irwell, at Manchester, are entirely excavated in a Glacial Drift of more than 150 feet of vertical thickness.

The average rainfall of western Lancashire is between 35 and 65 inches, steadily increasing eastward to the county boundary, which for the most part follows the Pennine watershed separating the rivers flowing into the Irish Sea, from those flowing eastward into the German Ocean. The Pennine Chain rises to an average height of 2,000 feet, and is composed of the Millstone Grit, which attains in Lancashire its maximum development in England.

The *Millstone Grit* is subdivided as follows:—

Rough rock, or First grit. Shale.
Haslingden flags, or Second grit. Shale.
Third grit. Shale.
Kinderscout grit, or Fourth grit. Shale.
Upper Pendle grit. Shale.
Lower Pendle grit.

The alternating character of permeable and impermeable material, and the deep ravines by which Millstone Grits are intersected, cause them to be extremely valuable for waterworks purposes; the rainfall sinking into the area of grit exposed at the surface, being supported and held up by the underlying and separating beds of shale: these cause the rainfall, that would otherwise have flowed away in devastating floods, to be stored up and delivered in springs, which maintain the dry-weather flow of the streams of upland Lancashire. A chain of waterworks may be followed from district to district in this formation, from Manchester waterworks at Longendale, to the Lancaster waterworks at the head of Wyresdale. In this chain of gravitation reservoirs, impounding the springs of the Millstone Grit, are those of the Preston, Blackburn, Padiham, Burnley, Todmorden, Wigan, Bury, Ashton, Oldham, and Bolton Corporations, those of the Rossendale and the Fylde waterworks, and also those of the Leeds and Liverpool canal. Nowhere can the Millstone Grit be better studied than in the picturesque district of supply of the Bolton Corporation waterworks around Belmont, on the eastern side of Rivington Pike; westward and northward of the ridge culminating in the Pike, are the Anglezark or Rivington reservoirs of the Liverpool Corporation waterworks, to which also belong the Roddlesworth reservoirs further north, the waters of which originally drained into the Darwen, and eventually into the Ribble. In nearly all the waterworks provision has been made for the wants of the mill owners, formerly supplied by these streams, by the construction of enormous compensation reservoirs, delivering in the case of Manchester fifteen million gallons a day. Mill owners have

been enormously benefited in having a regular daily supply sent down to them, instead of having to depend upon the capricious volume formerly coming to them, influenced by climatic changes of drought and floods. In many cases the provisions and engagements entered into by corporations with the mill owners appear to be so onerous, that, in exceptional years of drought, they ought to have Parliamentary relief from the penalty clauses of not being able to supply. Manchester at the time of writing has had to give clear spring water for mill purposes, the compensation water being exhausted, while a water-famine, as regards human consumption, stares the water-committee in the face.

I have long been of opinion, and have advocated in various papers, the great importance of constructing "dumb-wells" in areas of porous rocks, which, communicating with joints and fissures beneath, would receive the surplus rainfall, which is not sufficiently long on the surface of the rock to be absorbed, and therefore is either evaporated or passes off on to impermeable material and goes to increase the floods devastating the lowlands.

When sandstone or Millstone Grit is examined under the microscope, spaces are seen to exist between the grains of sand forming the rock. The size and extent of these spaces limit the capacity for water-storage of the rock, the water being stored between the interspaces, just in the same way that water is stored in a pail full of shingle into which water has been poured. In chalk and limestone the water is probably also held between infinitely small particles; but the chief water available for waterworks purposes in these cases is that present in cracks, fissures, and joints. In the latter rocks water is absorbed rapidly, but is parted with, with extreme slowness.

Rainfall falling on a surface of porous rock sinks until it reaches the plane of "permanent saturation," which varies within certain limits, being governed by the amount of annual rainfall. The higher this plane is situated in the rock, the stronger the flow of the springs issuing from its outcrop, and the longer will their efficiency be maintained. It is seldom that the full saturation level reaches to the top beds of a porous rock near its outcrop, but by a judicious selection of sites for "dumb" or "drainage wells," the saturation plane could be artificially kept up, the flow of the springs increased, and the consequent "dry-weather flow" of the streams during drought maintained. Recent examples have shown that heavy thunder showers are of no avail in replenishing the springs of rocks directly exposed to the surface; the ground being so hard that the rain does not percolate, and is caught up by the hot air and evaporated.

Ordinary wells can be sunk with great advantage in the Millstone Grit, yielding good supplies of soft water, free even from the small amount of organic impurity, due to a vegetable source, generally present in the gravitation waters of the millstone grit. As examples, I may mention three wells originated by myself in this formation. The well at Walton summit-level, for the Walton-le-Dale waterworks, in the third grit; the well of the Star Paper-works, Fenniscowles, near Blackburn, where the water overflows the surface, rising at artesian pressure from the first grit; and the well of the Leyland Local Board waterworks at Clayton Green, which gives a very plentiful supply of most excellent water. At the Eagley Mills, near Bolton, I advised the piercing of the beds, beneath the shales below the Rough Rock or first grit, with excellent results; and I believe if my report to the Bolton Corporation, as to sinking wells for the Corporation supply, had been carried out, it would have had equally successful results.

The *Middle Coal-measures* of the Lancashire coalfield consist chiefly of shales, with a few bands of rock, ironstone and coal-seams; there are no rocks of any value for waterworks purposes, corresponding to the sandstone of the Yorkshire coalfield, except possibly the rock associated with the Pemberton coal at Bryn, near Wigan. Not only are the sandstones thin, but are seldom at the surface, and are overlaid by impermeable shales and impermeable boulder clay, and their ends truncated by faults are not exposed to surface percolation. Beneath are the *Lower Coal-measures* or "gannister series," which contain the massive sugary quartz-like gannister rock, forming the eminence at Billinge Beacon; these in their turn are too hard and compact to be of any value for the sinking of wells.

The *Permian rocks* do not occupy a large area in Lancashire; the most important is the district lying between Preston and Garstang, near which town several domestic wells have been carried into them, but the supply is probably limited owing to the thick covering of boulder clay of impermeable character. At Clayton Vale, east of Manchester, a boring in search of coal proved a plentiful supply of water in the Permian sandstone, which has not yet been utilised; the supply being derived from water that has filtered through 1,000 feet of red sandstone should be of great value.

The *New Red Sandstone* of Lancashire consists of the following subdivisions:—

Keuper	Waterstones	100 ft.
	Building stones	350 „
Bunter	Upper mottled sandstones	350 „
	Pebble beds	1200 „

In the neighbourhood of Orrel and Waterloo private wells obtain good supplies from the Keuper sandstone, which is giving off springs in the Orrel railway cutting between Waterloo and Aintree. But the most important wells are in the Bunter division. The Southport Waterworks Company have their pumping station in the Upper Bunter at Springfield, near Ormskirk, and in the same neighbourhood the Upper Mottled Sandstone affords a good supply to Ormskirk; several million gallons a day could be obtained, if required, in this district. Further south are the new wells of the St. Helen's Corporation, at Knowley, yielding more than a million gallons from the Pebble Beds, the sites of which were chosen by myself; south of the St. Helen's coalfield are the old wells of that Corporation at Eccleston Hill, and Whiston. At Eccleston Hill the pumping has caused a considerable "cone of exhaustion;" consequently the water plane has been so depressed that springs which formerly issued at the foot of the hill have now ceased to flow. It is remarkable that so little is still understood of sanitary science, that an adjacent local board recently proposed to place a sewage farm over the site of those vanished springs, which flowed direct from the rock without any cover but a little sand! Eastward of the Eccleston well are numerous wells drawing on the underground stores of water of a triangular patch of New Red Sandstone, enclosed on either side by Coal-measures; the quantity so drawn amounts to a daily extraction equalling an absorption of ten inches of annual rainfall. on each square mile of surface exposed. Amongst these wells may be mentioned those of the Rainhill Gas and Water Company, and the Ravenhead Plate Glass Company. Further south are a group of wells belonging to the Widnes Local Board; they are placed in an area of former artesian overflow, but the level of the water is now pumped down.

Eastward are several wells sunk for the London and North-Western Railway, and the Cheshire Lines Railway, which prove the New Red to have thinned considerably, and the Coal-measures to be present beneath. At Winwick they are however at their normal thickness, and yield a magnificent supply to the Warrington Waterworks Company. At Warrington itself the underground water is salt, a boring at Dallan Lane Forge giving no less than 4,500 grains to the gallon. Westward, at Widnes, are numerous wells through thick post-glacial and glacial drift into the rock, giving large supplies.

At Liverpool four public wells yield an average of 6½ million gallons a day of excellent water, the deepest boring being 1,200 feet; they are separated from each other by a fault, but the water passes freely through it, whichever well is pumped,

when the next is standing unworked, getting an increased supply of water; the pumping of one of these wells affects the water in Oakfield quarry, $2\frac{1}{4}$ miles away. Several public wells and numerous private wells in the western portion of the City have had to be abandoned through excessive pollution and the percolation of salt water; the whole of these wells are west of the great fault, ranging through Liverpool and Bootle, which is evidently a water-tight barrier. That this is so is proved by the fact that the waters of Messrs. Preston's well at Bankfield, on the western side of the fault, are heavily polluted, while the Corporation waterworks well at Bootle, only a few yards east of the fault, yields a pure supply identical with that yielded in 1851.

The sands and gravels of the *Glacial Drift* formed an important source of water supply to the early inhabitants of the county, and probably led to the choice of site of Preston, Lancaster, Chorley, Euxton, Leyland, Prestwich, Bury, and scores of other towns; but as populations increased, the water so derived became dangerously polluted, and a specimen of the former supply to Leyland, derived from a well near the churchyard, collected by Dr. Frankland, is placed as an example of a thoroughly bad water in the Food Museum of the Science and Art Department in London. But in some cases valuable water for trade purposes can still be obtained from this source, a recent example of which is a well for the Lancashire and Yorkshire Railway at Preston Junction, suggested by myself, in co-operation with Mr. Muir, C.E., of Manchester. A superficial edition, showing the Drift deposits, is now published by the Geological Survey of England and Wales; Lancashire is completed, and Cheshire in progress.

The population of Lancashire is about $3\frac{1}{2}$ millions; this at 20 gallons of water a head means a daily requirement of 70 million gallons; with so large a demand and so crowded a population, it is no matter of surprise that both the Corporations of the cities of Liverpool and Manchester have gone beyond their own county for their future requirements; the former impounding the head-waters of the Severn and conveying them across the low watershed of the Dee to the Mersey basin; the latter abstracting the waters of Thirlmere Lake, and by artificially raising the level of that lake, rendering available for Manchester water that would otherwise have gone off in floods to the Solway Firth.

In my work on "The Water Supply of England and Wales," published in 1882, I made an attempt to show what was the probable supply of water available in all the river basins of England and Wales, and what was the amount required to

satisfy the demands upon that supply; with the result that it appears to be amply demonstrated that the rainfall this country receives is more than sufficient to meet all the requirements of human consumption, manufacturing processes, and the purposes of canalization; and yet, with these resources, large districts still suffer from all the ills of polluted water supply, whilst other areas are devastated by floods, representing unproductive rainfall passing to the sea. In no county would this unproductive rainfall be more valuable than in that of Lancaster, where water is not only wanted for human consumption, but for the varied processes of the trade of the district, and nowhere could it be more largely increased by dumb-wells, in the manner suggested.

Prof. A. Dupré, F.R.S. (London), said it would be a very admirable thing if some of the water which now came down the rivers during the winter months could be impounded for use during the summer; or if some of the rainfall could be stored and similarly used, they would then rarely hear any complaints about the fouling of streams.

Mr. A. E. Eccles (Chorley) said that if trees were planted on the moors they might have the effect which Mr. De Rance suggested, as water followed the roots of trees in rainy weather, and the presence of trees in any district ensured a greater amount of water in the earth.

Prof. A. Dupré, F.R.S. (London) said if he understood Mr. De Rance correctly, the wells were not to be used for storing water in the well itself, which would be an insignificant amount, but they were to give the rain-water falling on the surface access to the water-bearing strata below. In connexion with this he might mention that old artesian wells are used in various parts of France for getting rid of large quantities of waste water, proving that dumb wells might be used for the purpose suggested.

Mr. Nimrod Simmons (Bristol) asked whether it were intended to line the sides of the wells or have them porous.

Mr. H. T. Crook (Eccles) said he had some difficulty in clearly understanding the object of the paper, whether it was intended to advocate sinking for water in opposition to impounding, or whether it was to urge the adoption of "dumb" wells for regulating the supply to reservoirs. The prosperity of Lancashire was mainly due to her many streams and copious rains; to these she owed her position as one of the chief seats of industry. Any proposals dealing with her

water supply should be most jealously scrutinized, and no novel scheme undertaken without the most careful researches into the possible effects. This was the more necessary with regard to underground water because it was so exceedingly difficult to eradicate the popular notion that the rocks held a supply which was inexhaustible. Whenever there was a "scare" of a water-famine they always heard a great deal about this source of supply. It could not be too clearly driven into the public mind that whatever water was abstracted from the rocks below was so much taken from the discharge of the streams. Prof. Boyd Dawkins and even Mr. De Rance had sometimes he thought in their writings used language not sufficiently clear on this point. To show how little water might be available in the Millstone Grit they had the experience of works all along the Pennine chain, where something like 80 per cent. of the rainfall had been impounded; of the balance not more than 4 or 5 inches could possibly be available, and therefore to give to Manchester a supply equal to that now obtained from Longdendale, an area of some 236 square miles of country would have to be laid under contribution. With regard to compensation water he thought that Parliament might fairly be asked to consider whether some alteration might not be made in the amount to be given in seasons of exceptional drought such as they had experienced in the present year. The "dumb" well system advocated by Mr. De Rance he thought was surrounded with difficulties. The amount of water which each well would pass to the underlying strata would be very small, consequently a very large number of such wells would be required. To intercept the surface flow they must be placed on the lines of streams, and nearly every stream being utilized already very awkward questions of compensation would arise. The proposed system was merely impounding in a new form without the great advantage of the present surface system of knowing exactly what the effect of the operations will be.

Mr. C. E. De Rance, F.G.S. (London), in reply, said he felt it hard that after having written paper after paper during the last fifteen years, showing all water supply to be due to rainfall, he should have the last speaker apparently thinking he (Mr. De Rance) thought there was an inexhaustible underground supply. Mr. Bateman's figures just given, really included the underground water because the rainfall percolating, was returned to the surface as springs within the same drainage area. The dumb-wells would only absorb overflow or flood waters, and would therefore help to prevent floods. As to water rights, the position of the riparian owner would be improved, because the water which went into the wells would go to increase the springs, and to maintain the dry weather flow of the streams, the water absorbed during periods of excessive rains, being run off during drought.

On "*River Pollution in Lancashire, and How to Prevent it*," by JOHN COLLINS, F.C.S., F.G.S., F.I.C.

No apology appears to the writer to be necessary in the presentation of this paper to the Congress.

The subject of river pollution, not only in Lancashire but throughout the Kingdom, is one of daily growing importance, and this importance has been making itself felt in particularly inconvenient fashion of late years. For it must be observed that while the growth of population and the increase of trade processes and manufactories have been going steadily on, the needful amount of forethought and of prudent prevision has been wanting in the collection and in the conservation of water for domestic and for trade purposes.

There are probably few of the elder members who are in attendance at this Congress but who fondly remember how in their youth they were wont to go fishing and bathing in the limpid waters of the brook or river, which now they are regretfully constrained to stigmatize as a foul and offensive sewer.

The steadily increased burden thrown on our rivers by the increase of dense populations collected together in large centres, the corresponding increase in extent and variety of pollutants resulting from the trade occupations of these centres, as well as the accumulations of effete and excrementitious matters from these populations, all share in the cry for some attention at the hands of those in authority.

It would be superfluous to point to the effects on the health of the people who, from the nature of the case, are bound to live on the banks of these rivers, or as near thereto as may be.

These rivers are our "Wealth," and deserve our highest care.

Water, it must be remembered, absolutely pure, exists nowhere in nature. Even at the moment of condensation from invisible vapour to cloud, water always absorbs various gases which are present in the atmosphere. And when it falls as rain to the earth it sinks through the subjacent strata, or it flows over various surfaces, from which it takes up various matters in solution and to varying amounts. Hence it is that when we speak of polluting matters we refer to elements and compounds which are of a nature other than those aforementioned.

When used as a prime mover of machinery it is of the greatest value, and especially so where fuel is scarce or

expensive in use for steam purposes. But this mode of use of water in no way pollutes it, for it flows over, under, or through the "wheel" without material contamination.

And when the water coming from the hill side as a bountiful spring, clear and sparkling, is impounded for the supply of some town population, a certain amount is sent down daily by the water course as "compensation" water.

This comes to the first town or works on the stream in good condition, or, as we are in the habit of saying, "unpolluted."

The all important trades of the bleacher, printer, dyer, and paper maker are absolutely dependent on a plentiful supply of good water as an essential condition of a prosperous and a profitable trade.

And hence the water so required must be that which comes directly from the spring or other source, or it must be previously treated and cleansed to a degree to fit it for such use. Everywhere we find works after works occupying all available sites on the streams up to the nearest possible point to the source itself.

And so it comes to pass that the whole stream, which is, it must be remembered, the natural drainage outlet of the whole area or district through which it passes, is absorbed in or is applied to potable and to manufacturing purposes. And the extent of this evil—the magnitude of the interests, or the attainable margin of profits, is set up as a justification for such a monstrous use of one of God's best gifts.

If we proceed down stream from its source we find the various pollutions characteristic of and flowing from bleachers, dyers, printers, paper makers, and others, in most cases unfiltered, untreated, and without the slightest attempt at interception of noxious or polluting matters. In fact, we find a supreme indifference. And so we are not long in arriving at a point where the waters of the stream are worthless and useless for the ordinary trade purposes of the district, save for power.

Then we have this stream joined by others of a like character, and bearing similar burdens, and the pollution is intensified until it becomes unbearable.

Next we have the first sanitary authority we encounter complaining of this pollution by refuse from manufacturing processes, as well as by the sewage and drainage always found therewith.

All complain, even those who, while suffering from the inconvenience and annoyance which such a state of things entails, themselves add to the nuisance by following the general bad example.

The evils attendant on this state of things are not confined to the dwellers in towns, for all riparian land owners or residents

within miles suffer in many ways. The stream which flows through the pasture cannot be drunk by the cattle. The old house of the resident on the river bank is rendered uninhabitable by reason of intolerable stenches. People are subject to perpetual annoyance or even ill health, the money value of the property is diminished, houses are rendered tenantless and unsaleable, and "life on the waters" is rendered impossible.

We have hitherto spoken mainly of manufacturing refuse as the pollutant. This is surely a grave enough evil, but its remedy is much more readily applied than that from sewage.

The bleacher contributes nothing which may be properly considered a very serious pollutant.

The paper maker can, and in some cases does, apply certain arrangements to his mill effluent, which renders it practically innocuous.

The printer and dyer have a more difficult problem before them; but with settlement and precipitation, careful filtration, and other well-known means, they may also escape much outcry.

Sewage, however, is most serious, as it constitutes the greatest bulk of polluting foulness to our rivers.

It is a very variable but always complex liquid.

It includes excrementitious matters from privies and water closets, urinary matters from gullies, slop waters from the kitchen and washhouse, with its animal, soapy, and other refuse, and drainage from the stable, shippon, and slaughter-house.

Sewage is water polluted with an almost infinite variety of matters, some of which are in suspension, while others are in solution; but both are in such condition and quantity as to render the liquid foul and dangerous to deal with easily or successfully.

As the town sewer is the common receptacle for all sorts of domestic waste and effete matter, so it is also of manufacturing refuse, when such manufactures are seated in towns.

And thus the nearest river or stream is almost universally considered the natural and proper receptacle for all foulnesses. We may assume that the pollution increases as the river flows along in its course, and the appended tables show this, among other things, most markedly.

Organic animal matter found in polluted waters is most offensive of all, and it is most dangerous to health. The organic matters from print and dye works come next in order, and last, such pollutions as are contributed by certain chemical (trade) processes.

The writer does not propose to deal with the remedies for the state of things which exist, save so far as to suggest that comparatively simple and inexpensive arrangements will, and do, effect much and immediate improvement; and he is the less

disposed to do this on learning that other papers on the subject are to be submitted to the Congress.

It is obvious that filtration will do much to rid water of matters in suspension. But filtration can in no sensible degree affect pollutants which are in solution, and which are frequently most damaging and present in a large quantity. Filtration too must be carefully practised, or a mortifying failure is the certain result. The filter must be of a nature which is open enough to permit rapid oxidation of such matters as are intercepted by it, while not allowing the passage through it of such matters as it is the object of filtration to arrest. In other words, the more effective the filter is the more it is liable to choke rapidly, and the more care and attention it requires. It is always best to "settle" in properly constructed tanks or reservoirs before filtering, and in most cases it is here and at this point where the application of an agent to assist in or promote precipitation is easiest and most economical.

Where settlement, precipitation, and filtration do not effect the desired degree of clarification and of purification, other and special means to meet the case must be adopted; but it may be taken for granted that no pollution exists for which there is no remedy, and it is equally clear that this remedy should be applied by the person or authority which initiates the nuisance, and that before passing it on to his neighbour.

In support of this view it is worthy of note that most, if not all, the various pollutions with which our rivers are dosed are most readily removed if attacked at once, and before other reactions and compounds result.

It should be clearly understood that we must "prevent" the pollution of our rivers, and not attempt to "doctor" them after having drenched them with poisons. From the head of the stream to the mouth of the river we must be armed with legal powers to "prevent" the disposal of any waste, noxious or foreign matters, in such streams or rivers.

All we say is this: Take whatever you want, or at least, whatever you are entitled to, of the waters of the stream and use it for your own purposes, but return it to the stream in as fair a condition as you find it. Means are at hand to enable you to do this; but such is the immobility of public bodies, and of others who are interested in maintaining the present condition of things, that nothing short of a stern enforcement of the law which exists for our protection will ensure their adoption.

I have to express my thanks to my assistant, Mr. W. Hepworth-Collins, F.C.S., for his assistance in preparing the appended table results of analyses; and I am also indebted to him for several analyses made specially for this table.

Results of Analyses, tabulated for purposes of comparison. Grains per Imp. gal.

Description of Sample.	Solids.			Chlorine.	Ammonia.
	In Suspension.	In Solution.	Total.		
1. R. Irwell, above Bacup	0·32	4·62	4·94	0·8	0·003
2. „ below Bury, before confluence with R. Roach	11·13	17·11	28·24	2·6	0·331
3. R. Roach, above Rochdale	1·62	5·15	6·77	0·7	0·005
4. „ below „ before confluence with R. Irwell	16·21	21·03	37·24	3·2	0·301
5. R. Croal, before confluence with R. Tonge	0·93	5·10	6·03	0·6	0·003
6. R. Eagley, before affluent of R. Croal, before use	1·22	4·24	5·46	0·4	0·005
6*a*. „ at confluence with Astley Brook	11·08	21·16	32·24	2·1	0·164
7. R. Bradshaw, before use, affluent of R. Croal	1·06	6·21	7·27	0·6	0·003
7*a*. „ at confluence with R. Croal	9·57	22·17	31·74	1·7	0·626
8. R. Croal, at junction of R. Irwell	8·66	46·76	55·42	7·1	0·714
9. R. Irwell, below Radcliffe	10·22	43·09	53·31	5·9	0·621
10. „ after confluence with R. Croal	4·72	47·97	52·69	5·9	0·626
11. R. Irk, above Royton	0·62	4·55	5·17	0·3	0·003
11*a*. „ at Hunt's Bank, Manchester	22·03	50·21	72·24	6·2	0·702
12. R. Medlock, above Lees	0·63	6·01	6·64	0·5	0·003
12*a*. „ at Bradford, Manchester	11·72	46·25	57·97	4·9	0·397
13. R. Irwell, at Albert Bridge	19·31	45·11	64·42	6·2	0·802
13*a*. „ at Throstle Crest	12·90	47·74	60·64	7·9	0·816
14. R. Mersey, above Bredbury	2·15	5·92	8·07	6·8	0·005
14*a*. „ at Carrington	6·63	45·53	52·16	6·2	0·611
14*b*. „ after confluence with R. Irwell	17·15	40·02	57·17	6·4	0·621
15. R. Douglas, above Withnell	1·22	5·57	6·79	0·7	0·004
15*a*. „ at Wigan	13·91	36·20	50·11	5·5	0·506
16. R. Darwen, above Darwen, "Jack's Key"	1·06	6·73	7·79	0·9	0·006
16*a*. „ „ Blackburn	24·11	36·09	60·20	4·2	0·342
16*b*. „ at its confluence with R. Ribble	19·50	39·92	59·42	4·6	0·372
17. R. Ribble, above Cambeck	0·42	4·73	5·15	0·5	0·003
17*a*. Pendleton Brook, falling into R. Ribble at Clitheroe	35·83	32·44	68·27	2·1	0·292
17*b*. Barrow „ „ „ Mytton	24·10	36·11	60·21	2·7	0·303
18. R. Calder, at Whalley, affluent of R. Ribble	19·23	39·21	58·44	6·1	0·721
19. R. Hodder, at Hodderfoot	1·27	6·55	7·82	0·8	0·007
20. R. Ribble, immediately above Preston	17·44	37·72	55·16	3·1	0·414

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THE PREVENTION OF CONSUMPTION.

LECTURE TO THE CONGRESS,

By Arthur Ransome, M.D., F.R.S.

When I was asked to deliver a lecture before the Sanitary Congress at Bolton, I felt some little hesitation in bringing before it the subject of the Prevention of Consumption.

The prevention of disease is indeed the aim of all sanitary reformers, and I had little doubt as to the acceptability of an address aiming, with any likelihood of success, at the prevention of a disease of such importance as consumption.

But this was just the point at which some misgiving would creep in, and the question would arise as to whether there was sufficient evidence of the preventability of tubercular disease, as to justify me in bringing the subject before the members of this great Institute.

I think there is, but before venturing to bring my views before this meeting, I thought it well to ask for the permission of your Council.

This permission has now been freely given to me, and I must therefore, proceed to defend my thesis as well as I am able—and lay before you the reasons for my faith, and my grounds for thinking that this fell disease, the "scourge of England" as it has been called, may reasonably be called preventable, and by what means it may be prevented or at least be limited in its range.

I need not dilate much upon the magnitude of the task before us. About 70,000 persons die every year of tubercular disease in England and Wales, and as the average duration of the disease is now about three years, this means that there are nearly 200,000 persons in the country constantly suffering from the complaint.

How fatal consumption is to the adult part of the population, may be judged from the fact that more than a quarter of the total deaths between the ages 15 and 65 are caused by it, and nearly half between 15 and 35.

> "To see it down in figures on a page,
> Plain, silent, clear, as God sees through the earth
> The sense of all the graves, that's terrible
> For one who is not God, and cannot right
> The wrong he looks on." AURORA LEIGH.

It is the working years of men's lives that are chiefly affected by consumption. It is the malady of youth and middle life, and thus interferes more than any other with the economy of the State.

It carries off the most efficient of the population in the prime of manhood or of womanhood, and many of them are those who have given bright promises for the future.

Consumption often carries off the flowers of the flock—the most intelligent, the comeliest, the bravest and the best. They are cut down before they have accomplished a tithe of the great things of which their talents have given promise. Few can have failed to notice that many of those promising young people who have been thought worthy of biographical fame have finally succumbed to the onset of this fell malady.

The very magnitude of the work before us, and its extreme importance, is indeed the best excuse that I can give for bringing it before you; and if it can be proved to be within the bounds of possibility that such a disease can be prevented, the greatness of the task ought surely to be an additional incentive to attempt it, according to the Latin saying, "dignus vindice nodus."

But up to quite a recent period, not only was consumption deemed to be incurable, it was also regarded as almost inevitable. Families in which existed the taint of the disease were supposed to be doomed: a certain number of them were certain to succumb to the hereditary curse.

Insurance offices still refuse to enrol amongst their members those who have lost father and mother from the disease, and even collateral relatives who have died from it are judged to have an influence upon the life of the candidate for life assurance. It was also common amongst workpeople who worked at unhealthy trades, such as steel-grinding, glass-cutting, mining, &c., to regard the mortality from consumption amongst them as only natural and part of their fate. A fork-grinder once said to Mr. Hall, of Sheffield, "I shall be thirty-six next month, and you know that is getting an old man at our trade." And another, a young man of about twenty-six years, said he

"reckoned in about two more years at his trade he might begin to think of dropping off the perch;" adding, "You know a knife-grinder is an old cock at thirty."

Whilst these forebodings were held with regard to those who came of a consumptive stock, and those who followed certain trades, the fate of the consumptive himself was regarded as hopeless.

In my student days I have over and over again seen physicians regard the stethoscopic sounds that revealed the commencement of tubercle, as equivalent to a sentence of death, and even the late Sir Thomas Watson, in his classical work on the "Practice of Physic," says: "The tubercular disease when established is beyond our power." (Vol. II. p. 201.)

Niemeyer again remarks: "Many a patient gets well, who would formerly have been assumed to be a victim of tubercular and therefore incurable disease. I am fully convinced from my own experience of the last few years that in former times I lost many a patient from galloping consumption, only because I considered him lost from the very first." (Lecture on Consumption, p. 65.)

Even before the discovery of the bacillus of tubercle, these views of the inevitable character and the incurability of consumption were already beginning to be doubted.

It was shown by Dr. Pollock, in his work on the "Elements of Prognosis in Consumption," that: "Many cases which were given up by doctors, but outlived the prediction to arrive at old age, were undoubtedly recoveries from phthisis. Many more were instances of an early invasion of the disease with subsidence of the symptoms and long tolerance of the deposit" (p. 68). Again, he says: "I have many times witnessed all the phenomena of deposit, and all the symptoms of phthisis entirely removed" (p. 117). "The best authorities lean to the opinion that tubercle is capable of removal by absorption" (p. 119.)

Dr. T. C. Williams remarks that the animal matter of tubercle may be absorbed; and Dr. Carswell says, "the curability of this disease has in my opinion been settled by Laennec"; and my old master, Dr. Stokes of Dublin, says, "there is no doubt that modern practice has proved the curability of phthisis," adding, "it is probable that many more cases of phthisis recover than is supposed." (Lectures in 1835.)

I have myself seen many cases of what might fairly be called cure, seeing that the patients lived thirty or forty years after undoubted cavities had formed in their lungs. Still more frequently have I recorded cases in which incipient disease had been arrested, and no physical signs were to be found afterwards in the lungs. Within the last twenty years also it has become evident

that there has been a distinct diminution in the death-rate from phthisis throughout the country.

In the three years, 1858 to 1860, the annual rate of mortality from consumption per million of persons living was 2567. In 1884 it was only 1818, a diminution of 749 per million, or a total saving of about 20,000 lives every year.

Nor is this improvement confined to England. "In 1857, 39·50 deaths from consumption were returned in the State of Massachusetts for each 10,000 of the population; in 1883 only 29·90. This decrease is too large to credit to greater accuracy in diagnosis and to the transference of consumption to other States, and is mainly attributable to the prevention of phthisis by improved hygiene." (Strumpel. "Text Book of Medicine," p. 213.)

Evidence has also been forthcoming of the strongest kind, of the influence of sanitary measures, and especially of good drainage and good ventilation, as a preventive of consumption.

No better instance of this could be found than in the records of the mortality from this disease in the British army and navy. This evidence was collected by the commission on the sanitary state of the army, 1858, and the results are shown in the following table which has frequently been quoted before, but which can hardly be too often brought before public notice. This mortality is given at several stations for several successive periods, and I think that you will be at once struck by the enormous death rates amongst the troops in the earlier period, and at every one of the stations, and the great reduction of the rate in 1874, and at the present time it is still further reduced.*

Mortality per 1,000 of Strength.

	1830 to 1837.	1837 to 1847.	1863 to 1872.	1874.
Household Cavalry	14·5	11·1	9.17	8·79
Cavalry of Line	15·3	13·5		
Foot Guards	21·6	20·4		
Mediterranean Stations	21	16·4	11·2	7·27
Canada, &c.	23	17	9·49	6·0
Jamaica, &c.	91	59	17·05	16·9
Madras, India	52	—	24·2	14·22
Bengal "	44			
Ceylon	49	—	21·95	6·04

Rates of Mortality at the same ages prevailing in healthy country populations .... 7·7

In England and Wales .... 9·2

In Manchester .... 12·4

The greater part of this excessive mortality was due to consumption.

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* In 1883 it was only 6·28 per 1000, and throughout the world only 9·57.

Dr. Buchanan, now Medical Officer to the Local Government Board, has also conclusively shown that good drainage of a locality may diminish by one-half the prevalence of the disease, as in the case of the city of Salisbury.

These proofs of the preventability of consumption, were accumulated long before the discovery by Prof. Koch, that in most cases the disease originates outside the body, that it is due to the minute micro-organism named by him the bacillus of tubercle, and that its ravages are fostered by various external conditions, most of which are distinctly under the control of appropriate sanitary measures.

Since then it has become increasingly evident that Louis was right when he said, that "few persons were born necessarily to die of the disease," and it has been now abundantly proved that consumption is eminently a preventable disease.

But before proceeding at once to the inquiry how it may be prevented, let us for a few moments consider what tubercle is now ascertained to be. An amusing imaginary conversation given by Dr. McCormack, will serve to show the stride that has been recently made in our knowledge on this point.

"If you ask a pathologist what tubercle is, he will perchance reply, readily, that it is a certain deep-seated or, peradventure, superficial tumour which possibly tends to suppuration. You quietly remind him, that you do not ask where it is seated or to what it proceeds, but only what it really is. He will then, it may be, inform you that there are tubercles yellow, gray, and miliary, nay fibroid, induced by depressed vital powers, in short a defective decaying tendency in the bioplasm. You rejoin as gently as may be, that you do not care a button about their color or size, and as for depressed vital powers you consider that mere φλυαεία, since you only desire to learn what tubercles actually are."

"The pathologist now takes himself up a little, as a Frenchman might say, and briskly states that tubercle in fact is a morbid material which, being deposited on the mucous and serous surfaces and in the areolar tissues, destroys the elements which it implicates. In the excess of your courtesy you beg his pardon, and just remark that you do not want to learn where the material in question is deposited or what tissue it destroys, but only what it assuredly is. By this time our pathologist's colour becomes ever so little heightened; still he answers confidently that tubercle, as resulting from a pathological alteration, degenerates into an opaque, then a friable, lastly a purulent substance, which— But here you boldly interrupt him with the observation that not yet has he replied to your inquiry as to the real nature and essence of tubercle.

The pathologist, if he be a candid person, as pathologists commonly are, then confesses, as he might just as well have done at the outset, that he knows nothing whatever, the real nature of tubercle regarded, about the matter."

Fortunately we know something more than this now of the intimate nature of tubercle. Thanks to Prof. Koch we know that it is constantly associated with the presence of a micro-organism which, either by its own initiative power, or by means of the products of its activity, causes the formation of the bodies called tubercles within the textures of the body, that it makes its entrance from without, and that, once lodged within the frame, it travels infectively through it, chiefly along the course of the lymphatic system.

The conditions of its existence are briefly those to be found within the animal body—a certain degree of moisture, a temperature of about 37° Centigrade (from 86° to 107° F.), and a supply of nitrogenous food, such as blood serum will give.

If cultivated outside the body all these conditions must be imitated, and there is further the very important observation that it needs for its development a sojourn of at least a week, and sometimes much longer, in these conditions before it can take root, so to speak, and grow. Moreover, it is a being of very tenacious vitality, and it will preserve its virulence and capacity for development for six weeks or longer in decomposing tuberculous material, and for six months at least in a dry state. It also resists the action of many germicides.

Its close connection with tubercle has been proved, (1) by its almost constant presence in tuberculous cases; (2) by its absence in all other diseases; and (3) by pure cultivations of its colonies being injected into the body, causing tubercular disease of the parts inoculated.

Once in the body, there is unfortunately hardly a structure which tubercle does not implicate, a function which primarily or secondarily in its sequences it does not invade and derange. As Dr. McCormack forcibly says, "No tongue could narrate, no pen indeed declare its deplorably frightful ravages. The exquisitely beautiful fabric of the eye does not escape, much less with all their admirable mutual adjustments, the muscles, joints and bones. The entire living material fabric, this so magnificent handiwork of God, is in truth disintegrated, defaced, and destroyed. The interior and exterior tissues waste and wither, the fingers become misshapen, the nails curve over, the muscles both of organic life and the life of relation, no longer adequately nourished, lose their volume, the lung tissue, as Rokitansky tells us, ulcerates and disappears. The breath is as if from a vault, and in laryngeal phthisis, the poor sufferer,

spitting, choking, coughing, is perhaps carried off by suffocative spasm of the glottis at last."

Now, how may consumption be prevented? The answer to this question depends upon the reply to the further inquiry—what are the conditions that enable the tubercle bacillus to enter the body in a virulent form, and what further are those that enable it to do its deadly work there? As Cicero has aptly said, "Physicians consider that when the cause of a disease has been discovered, they have also discovered its cure." At least if this is not quite true they can often prevent disease.

Let us first dispose of a number of influences, formerly supposed to be causes of consumption that have now been proved to have only a remote or doubtful effect upon its course.

1. *Climate.*—At one time it was supposed that climate was everything, both in the prevention and cure of consumption, but it has now been shown to be almost entirely without influence except so far as it permits or discourages an almost entirely open air life.

Wherever human beings are congregated together, in every part of the habitable globe, and in all climates, there is consumption to be found. It is as Dr. Lombard says "a ubiquitous malady."

It would almost be sufficient to point to the table of Army Mortality for the proof of this assertion, but I have also drawn up a table from Dr. Lombard's statistics showing its great prevalence in most of the capital cities of Europe, and in other parts of the world.

It will be seen that it is almost equally prevalent in the South as in the North, in the East as in the West.

Even in the places where there is the greatest exemption from the disease, in the desert, on high mountain ranges, and in Arctic or Sub-Arctic regions it is still to be found under certain unsanitary conditions. In Asia Minor it is often met with on the coast or in the principal towns. The Bedouins on the coast of the Red Sea, "who exchange their tents for stone built houses," suffer from it. In Syria it is met with at Aleppo, and in the Soudan at Khartoum.

In Algeria whilst the Nomad Arabs are free, "amongst the captives many die of the disease."

The same observations may be made regarding Australia and North and South America, including Canada and the Arctic regions.

Even in the high lands of Switzerland there is no complete immunity from the disease. Amongst those of the population who are attracted to in-door employments, as Dr. Emil Müller has shown ("Distribution of Consumption in Switzerland"), a

certain proportion die of the disease. Industrial in-door pursuits give rise to a rate varying from 6·5 to 10·2 per cent., and one of the highest of these rates, 9·8, is at an elevation of 3,400 to 4,400 feet. At 4,400 to 5,000 feet of altitude, in mixed labour the rate from the disease was 7·7 per cent.

Here, then, again we find the conditions of life a much more powerful influence than climate or elevation of site.

2. Take next exposure to cold, privation, and hardship of all kinds; only remotely are these causes of consumption.

It is true that there are still medical men who regard them as the chief agents in preparing the human frame for its ravages; thus Dr. Jaccoud affirms that the consumptive constitution is essentially due to "insufficient nutrition, taking this word in its widest sense," and Mon. Bouchardat, in his recent treatise on Hygiene, affirms that "the continuous loss of calorific elements, in any considerable proportion, leads to pulmonary tuberculosis," that it is due to some form of "*misère physiologique*."

But the Army Medical Reports again afford a sufficient answer to this hypothesis. The phthisis that at one time carried off so many of the finest soldiers of the British army, was not brought on by starvation, or privation, or exposure to hardship. It occurred for the most part when they were not on active service, but in the time of peace, when they were well fed and well cared for in every material respect, far better in fact than the half-starved artisans and agricultural labourers, who only died at one-third the rate that they did.

Again, the poor fishermen of Iceland, and the hunters and trappers of North America, the nomad tribes of Asia and Africa, the wretched natives of Australia, all these people escape the disease almost entirely, whilst half the deaths of the well-protected, well-clothed, adult inhabitants of towns, are from this cause.

The Highlanders who inhabit well-built houses on the mainland of Scotland are subject to it at the same rate as the other inhabitants; whilst the ill-fed, ill-clothed fishermen of the Hebrides, who are of the same race, hardly ever contract the disease.

It is quite true that inflammations of the respiratory apparatus, especially of the tissues of the lungs and pleura, constitute a remote or predisposing cause of consumption. These diseases are apt to destroy the natural elasticity of the lungs and render them unable to dislodge or to destroy the micro-organism which may succeed in finding an entrance into them, and which thus may plant itself firmly into their substance, irritating them and ultimately leading to consolidation and subsequent softening.

If the conditions are such as to lead people easily to take cold, and if they thus produce what is called chronic catarrhal

pneumonia, they leave a condition of the lungs that both facilitates the lodgment in them of the tubercle bacillus, and also prevents its expulsion or destruction by the natural forces of the human economy. Some physicians believe that nearly all cases of phthisis commence in this way. Niemeyer says, "Tuberculosis is in most cases a secondary disease," p. 15; and Dr. Herman Weber observes, "A fruitful source of phthisis is the tendency to catarrh of the respiratory mucous membrane;" and he further points out how these catarrhs may lead to phthisis: "(1) By producing numerous mucous abrasions upon which the bacilli can settle; (2) by weakening epithelial cells and their ciliary action; (3) by rendering respirations more shallow; and (4) by weakening the nutrition and energy of the whole system."

In the light of modern research it is not difficult to understand why a loss of elasticity of the lung should lead to consumption. We have seen that the bacillus of tubercle needs for its development a sojourn of at least a week in contact with suitable nourishment, and at a temperature nearly approximating to that of the human body. It is also highly probable that in all towns and places where men most congregate some of these infective particles are present in the atmosphere, but they are for the most part quite harmless to healthy persons. One reason why they are thus harmless may well be the difficulty with which these particles could make their way along the air passages of the lungs of such people. They are constantly liable to be arrested on the moist surfaces of the mucous membrane; and, if they are once caught in this way, they will soon be passed out of the chest by the delicate "cilia" that line the tubes. Even if they should penetrate into the ultimate lung tissues also, they are likely to be destroyed by the fresh blasts of air that rush freely into every portion of a healthy lung.

These safeguards, however, are not present in lungs that have either been compressed by constrained postures, or that have lost their elasticity through inflammatory actions. The germs of the disease, therefore, if they can penetrate the inactive portions of such damaged lungs, may both find there suitable food and warmth, and may rest long enough to develope true tubercular irritation.

In complaints such as simple catarrh and bronchitis, in which there is a copious secretion of mucus, I am inclined to think that there is less reason to fear a permanent lodgment of the bacillus. This organism is, in fact, likely to be entangled in the frothy secretion, and to be expelled along with it before it can do harm.

Some years ago, in an enquiry into the nature and quantity

of the organic matter of the breath, I was much struck with the fact that in bronchitis and catarrh, and other diseases in which there was much expectoration, the proportionate amount of this substance exhaled in the aqueous vapour from the lungs was only one-half of that from healthy persons; not that there was really less organic matter thus excreted, but because it was taken up by the mucus before it could reach the mouth.

Professor Tyndall has also shown, by means of his illuminated tube, "the filtering action" of the lungs—all dust inhaled being caught up by the bronchial secretion and prevented from appearing in the expired air. It would equally be prevented from travelling into the air cells. Something of this kind must always go on in such diseases as those in question.

But even in chronic bronchitis, after a time, the expulsive machinery may become defective, the waving cilia may become less active, the muscular apparatus of the tubes may be weakened, and dilatation and plugging of the air passages may occur; thus the bacillus may find a lodgment within the lungs, and true tubercular disease may be set up. This specific infection is again still more likely to take place if from any cause the ultimate tissues become inflamed, as in the various forms of catarrhal-pneumonia or broncho-pneumonia. In this case, even more than in simple catarrh, the lung loses its elasticity, its tissues are more open to infection, the residual air becomes stagnant, and its impurities, including foreign germs, are liable to be imprisoned for an indefinite time. In such a sense as this then, the causes of inflammatory diseases of the chest are also the causes of consumption.

But is exposure to the elements as fruitful a cause of cold-catching as is commonly supposed? Do we find that men who are much in the open air are more likely to take cold than the inmates of well warmed and well closed apartments? Quite the contrary. Soldiers on campaign, sailors, fishermen, hunters, gipsies, engine-drivers, coachmen, gardeners, agricultural labourers, none of these people suffer much from catarrhal affections, unless they are intemperate. To quote again from Dr. McCormack (p. 40), "Arctic explorers, supplied indeed with food and clothes, confront with perfect equanimity the chilliest air that ever flowed. Whymper safely slept, he tells us, *sub divo*, in chill Alaska, with only a screen to windward, when the mercury in his barometer was frozen hard. Von Wrangel relates quite a similar experience in respect of the dwellers by the shores of the Arctic ocean."

It is interesting to notice also the immunity from cold exhibited by our volunteers when they camp out for a week or a fortnight, and the instance has the more value because most of

these men are unaccustomed to an open air life, and have for the most part of their days been the occupants of close offices or stuffy warehouses.

I have known men to be thus exposed for a great part of their time not only to cold, but to drenching rain, with pools forming under their beds in the tents, and yet not a single man in a battalion has been invalided from the effects of cold.

On the other hand we know that the inhabitants of towns not only contract diseases of the lungs, but die of their consequences in excessive numbers. It has been calculated that in Manchester people die of these complaints at more than three times the rate that they do in breezy Westmoreland. Mere exposure to cold, and hardship, and privation, are not therefore to be reckoned as causes of consumption.

3. The next supposed cause of consumption to which I shall allude is the inhalation of irritating substances, or dusts arising from works of various kinds, such as steel grinding, glass cutting, brush making, &c.

In the year 1858, Dr. Headlam Greenhow presented to the Privy Council a report in which he pointed out the influence of occupation as a cause of pulmonary diseases. In 1860 and 1861, he returned again to the subject and dwelt especially upon the large mortality from these complaints, amongst those who worked in an atmosphere impregnated with dust consisting of fine particles of metal or of sandstone, &c.

His statistics, although very valuable in many ways, are nevertheless open to criticism in reference to the causation of consumption. He groups together many very different forms of lung affection—many that are not tuberculosis at all—and he was not able in many cases to discriminate between the effects of the occupation itself, and those of the conditions under which it was carried on.

No one, indeed, who has studied the vital statistics of these occupations, or who has medically attended the workpeople, can doubt the power of irritating dusts in inducing a state of the lungs that is favourable to the reception of the specific organism.

Just as in the case of lungs otherwise injured, tubercle may readily be engrafted upon a miner's or a needlemaker's lung; but the disease that is first caused by the particles these men inhale is not tuberculous at all. It is simply a chronic inflammation, affecting chiefly the connective tissue and the formation of a fibroid tissue in the alveolar wells. It leads ultimately to a contraction and, so to speak, to a strangling of certain portions of the lung tissue. But no bacilli are found in either the tissues or in the expectoration of such patients, as I can testify from frequent stainings.

I have myself watched many of these cases affecting persons who have lived under otherwise healthy conditions, and although they have ultimately succumbed to the exhausting effects of the disease, yet from first to last they have kept free from the infection of tubercle. The cirrhosis, or fibroid disease, as it has been called, has never degenerated into true consumption.

Dusts, therefore, although they are a serious danger, and they ought on this account to be kept away from workpeople as a preventive measure against consumption, yet are only remotely a cause of the disease. Much the same must be said of stooping postures during work.

4. I would say a few more words on the subject of hereditary predisposition to the disease.

That this is a real source of danger no medical man would deny. Thus we have seen instances of families in which almost every member has died of the disease, and others in which members of the same family living in different and far distant places, have yet one and all ultimately succumbed to it. In every such instance however, so far as I am aware, something has been added to the mere vulnerability of the persons attacked, either residence in confined air, repeated attacks of cold or some other assisting cause. And such a tendency to contract the disease can only be regarded as a remote and not as an essential cause of consumption. There is no need to assume the existence of a tubercular constitution any more than there is to affirm that there is a diphtheritic or typhoid constitution when a family is unusually predisposed to these disorders.

I know, for instance, of one family in which six out of eleven children have died of diphtheria, and other members have suffered from the complaint. They were not all struck down at the same time or by the same epidemic, but three children died in one place, one at another, and two in the village where the family is now residing. Such a fatality as this from a particular disease means nothing more than a tendency to contract it, and a readiness to give way before its attacks.

It is, moreover, highly probable that heredity has much less to do with consumption than is commonly supposed. A very large proportion of cases arise without any phthisical family history in the past. Many healthy families leaving the country and coming to reside in crowded towns lose some members subsequently from consumption. In the army more than 60 per cent. of cases are non-hereditary. Even when we take the difficult test of statistics we find they are apt to be deceptive. Thus Briquet found that one-third of the consumptive patients at a hospital were born of consumptive parents on one side or the other; Dr. Quain 25 per cent; Dr. T. C. Williams 12 per

cent. of direct influence, and 48 per cent. of family predisposition. But in these figures no account is taken of the influence of external circumstances, circumstances that are common to all the members of the family.

Again, there are so many deaths from phthisis in the country (as I said before, about half of all the deaths between the ages of 15 and 35 are due to this cause), that, without any such thing as hereditary taint, there would be nothing surprising in the fact that half of the consumptive patients have had consumptive relatives.

Dr. Walshe, the chief authority on chest diseases in this country, obtained from his hospital patients the result that about 26 per cent. came of a father or mother, or of both parents similarly diseased; but in discussing the significance of these figures, he asks whether they prove the reality of hereditary influence, and decides that they do not. "This ratio," he says, "of 26 per cent. might be, and probably is, no higher than that of the tuberculized portion of the population generally," and he concludes that "much phthisis is, in each generation, non-hereditary."

In any case it is highly probable that this influence has been greatly overrated. If the true causes of consumption are avoided, even those who come of a consumptive stock will escape the hereditary curse. As Louis says ("Recherches sur la Phthisie," p. 532): "Nous n'avons recuelli aucun fait en faveur de l' hérédité de la phthisie."

We are now prepared to consider certain conditions that seem to be more essential to the virulent activity of the micro-organism, and

(1) I would mention bad drainage of soils upon which houses are built.

The Commission on the sanitary state of the army in 1858, whose report I have already quoted, combined as chief agents two causes, and affirmed plainly that "the ravages committed in the ranks of the army by pulmonary disease are to be traced in a great degree to the vitiated atmosphere generated by overcrowding and deficient ventilation, and *the absence of proper sewerage of barracks*. In 1864 Mr. A. B. Middleton also called attention to these two sources of danger in a paper read before the British Association at Bath, but in an independent enquiry conducted in 1862 in Massachusetts by Dr. Bowditch, the extreme importance of dampness of soil as a cause of consumption was insisted upon.

He came to the conclusion that—(1) "A residence on or near a damp soil, whether that dampness is inherent in the soil itself or caused by percolation from adjacent ponds, from

marshes, or springy soils, is one of the primal causes of consumption in Massachusetts, probably in New England, and possibly in other portions of the globe. (2.) Consumption can be checked in its career, and possibly, nay probably, prevented by attention to this law."

Shortly afterwards, and without any knowledge of Dr. Bowditch's conclusions, Dr. Buchanan, who is now the chief Medical Officer to the Local Government Board, came to much the same conclusions as the result of an elaborate research into the distribution of consumption in the three south-eastern counties of England beyond the limits of the Metropolis.

His conclusions are well worthy of being quoted *in extenso*—they are as follow:—

(1.) Within the counties of Surrey, Kent, and Sussex, there is, broadly speaking, less phthisis (*i.e.*, consumption) among populations living on pervious soils than among populations living on impervious soils.

(2.) Within the same counties there is less phthisis among populations living on high-lying pervious soils than among populations living on low-lying pervious soils.

(3.) Within the same counties there is less phthisis among populations living on sloping impervious soils than among populations living on flat impervious soils.

(4.) The connection between soil and phthisis has been established in this enquiry—(*a*) by the existence of general agreement in phthisis mortality between districts that have common geological and topographical features of a nature to effect the water-holding quality of the soil; (*b*) by the existence of general disagreement between districts that are differently circumstanced in regard to such features; and (*c*) by the discovery of pretty regular concomitancy in the fluctuation of the two conditions, from much phthisis with much wetness of soil, to little phthisis with little wetness of soil. But the connection between wet soil and phthisis came out last year in another way, which must here be recalled—(*d*) by the observation that phthisis had been greatly reduced in towns where the water of the soil had been artificially removed, and that it had not been reduced in other towns where the soil had not been dried.

(5.) The whole of the foregoing conclusions combine into one—which may now be affirmed generally, and not only of particular districts—that "wetness of soil is a cause of phthisis to the population living upon it."

(6.) No other circumstance can be detected, after careful consideration of the materials accumulated during this year, that coincides on any large scale with the greater or less prevalence of phthisis, except the one condition of soil.

These results have since been confirmed by Dr. Haviland, and by the Registrar-General of Scotland. In the conclusions drawn from his map of the distribution of phthisis in England and Wales, Dr. Haviland says: "Damp, clayey soil, whether belonging to the wealden, oolitic, or cretaceous formation, is coincident with a high mortality;" and the Registrar-General, in his seventh report, remarks that "the towns, villages, hamlets, or houses which were situated at or near undrained localities, or were on heavy, impermeable soils, or on low-lying ground, and whose sites were consequently kept damp, had a very much larger number and proportion of cases of consumption than towns, villages, hamlets, or houses which were situated on dry or rocky ground, or on light porous soils, where the redundant moisture easily escaped."

The vapours that arise from damp ground, and which make their way into houses, are often very impure, and charged with organic matter that may be a suitable food for the tubercle bacillus.

In an address to this Congress, held at Leicester, the year before last, I gave the details of an inquiry into this subject that goes even further than those already cited—a contrast between two populations, one being on clay lands, the other on a hill of sand. The result was derived from a ten years mortality table, and was that whereas in this period there had originated forty-four cases per 1,000 inhabitants on the clay lands, on the sand only one per 1,000 had thus suffered, and that not one of the children or females of the population who were constantly resident there had contracted the disease. In this instance, however, we had only the influence of a dry soil to deal with; the houses were those of well-to-do people, and were fairly well ventilated. Whether there would have been the same immunity under other conditions is very doubtful.

Still it is evident from the facts before us that there is a close relationship between the condition of the soil and consumption—a relationship so close that, as we have seen, a residence on a porous soil, under otherwise favourable hygienic conditions, will apparently preserve the whole community from the disease.

It is further noticeable that in these cases hereditary predisposition made no difference in the result. There were present in these populations many whose parents or near relatives had died of the disease, and yet they did not contract it so long as they lived in the place. I think it may therefore be fairly assumed that in a well drained, uncontaminated soil, we have one of the means by which consumption may be prevented.

2. But we still have to consider the most prolific source from which the bacillus of tubercle derives its virulence—a cause

without which neither starvation, nor exposure, nor hard work, not even probably hereditary predisposition will bring on consumption. It is a cause that is common to rich and poor, that is to be found in all climates, in all collections of human beings, and that is only absent in the places where consumption is not to be found. In two words, it is *foul air*, and for the most part it is air that has been rendered foul by previous respiration.

It is to Dr. McCormack that we owe the most definite statement of this now well-recognized influence, and as he says, "wherever there is foul air * * * * there we meet consumption, there we meet scrofula, and an untimely death."

His further theory that tubercle is due to "carbon and other impurities inadequately discharged during the process of respiration" is now not tenable, but his demonstration of the danger of breathing air that has been breathed before is of none the less value.

Let me very briefly bring before you the grounds for this opinion.

1. We have the fact that increased density of a population means also increased general mortality, and especially increased mortality from lung disease. The late Dr. Farr was the first to establish this fact, and to reduce it almost to a mathematical demonstration.

In proportion as larger and larger numbers of persons are attracted to a certain limited area of ground, in that proportion, *cæteris paribus*, does the mortality from consumption increase.

It is true that we have along with this condition a combination of most, if not of all, the other circumstances unfavourable to health—poverty, insufficient food, low site and often damp ill-constructed dwellings; and we might with equal right select any one of these things as the true cause of the disease, but for the strong fact that all these things exist, in still greater intensity, in some country districts of England, or in the poorer villages of Scotland, along with a very low rate of mortality from consumption.

2. We have the evidence, that is now most ample, that in proportion as people are attracted to indoor occupation, and in proportion to the degree of closeness and bad ventilation of the places in which they work, in that ratio is the rate of mortality from consumption increased. This fact was first demonstrated by Dr. Greenhow in his statistical inquiry, but it has since been fully confirmed by other observers.

Any one who looks at the map of the distribution of consumption in England prepared by Mr. Alfred Haviland, must be at once struck with the deepening of colour that shows intensity of disease in the great industrial centres of the country. The

influence of this cause is also shown by the contrast between the male and female rates of mortality in town and country districts.

In some parts of England the men are the chief workers at indoor employments—as in Sheffield and Birmingham; there you find the male rate the highest; in others, as at Nottingham, Huddersfield, and Macclesfield, the women are most employed, and consequently they die most numerously of consumption; and in places like Liverpool and Manchester, and Stockport, where there is little difference in the employment of men and women, there is also little difference in the rates of mortality from consumption; both are high.

But the most striking testimony is from the relative death-rates in the two sexes in country places, such as Market Drayton, Bakewell, Nuneaton, Camelford, and Pickering. Here, where the men are constantly out of doors, their consumption rate is uniformly low, while the women, who keep the house, die at a constantly higher rate of this disease.

3. We have the experience given to us by the records of the mortality from consumption in the British Army and Navy, and a similar history could be told of the European forces.

In the exhaustive report of the Commissions upon the Sanitary State of the Army, it appeared that lung disease was more than twice as fatal amongst the picked men who formed the army as it was amongst the ordinary civil population of the country (12·5 of the former to 5·8 of the latter).

They pointed out that in civil life, insufficient clothing, insufficient and unwholesome food, sedentary and unwholesome occupations, and the vitiated atmosphere of unhealthy dwellings, all contribute to the propagation of this class of diseases. But in the army it cannot be alleged that the clothing, the food, or the nature of the occupation in itself, are of a character which would justify the imputation that they are among the predisposing causes of the excessive mortality of the soldier by pulmonary disease. (Report of Commissioners on the Sanitary State of Army, 1858.)

I have already given their opinion as to the true causes of this contrast.

4. I have lately had occasion to examine into the distribution of phthisis in certain districts of Manchester and Salford, and have ascertained that in every case the parts of these districts most affected by the disease are the close courts and alleys, the shut-in streets, and especially the back-to-back houses.

5th and lastly. We may take an entirely different method of proof and we can show that wherever, in different parts of the world, there is an abundance of fresh air in the dwellings of the people, there is to be found a comparative immunity

from the disease, even though most of the other surroundings are, in a sanitary point of view, almost as bad as they can be.

On the whole I think it may be regarded as fully proved that the breathing of air rendered foul by previous respiration is one of the conditions required to enable the bacillus of tubercle to take root and to grow in the lungs of human beings. Similar evidence is also forthcoming as to its influence upon animals—horses, cows, monkeys, &c.

It is important then to inquire what are the ingredients in respired air that are thus so potent for evil.

We can of course easily answer for one of them, and it might be supposed sufficient to account for all the facts that have now been brought forward. I mean the presence of the tubercle bacillus itself. This must needs be present in such air, or the disease would not arise. It must come originally from the body of some tuberculous patient. It may have come directly from the breath, as it has been found in the watery vapour exhaled from the lungs of such persons; but it is more probably mixed up with the dust in the air, forming one of the innocent looking motes that dance in a sunbeam. It may have been at some time or other derived from the dried up excretions of some poor comsumptive, by its inherent vitality outliving its victim; but the strange part of the story is that the micro-organism cannot do its work unless it is assisted by the presence of other impurities. We cannot doubt that the creature is given out into well-ventilated, as well as into badly aerated spaces, and yet so far as we know it never communicates the disease in the former case.

How is it that in the wards of a consumption hospital, or in the sick rooms of well-ventilated houses, it never attacks the attendants? Even in the confined dwellings of the poor direct contagion, in this country at any rate, is a very rare event, and where drainage and ventilation are good I have never heard of or seen any case of direct transmission, even where there has been ample opportunity for breath to infect breath, as in the case of husband and wife or sisters sleeping together.

So far as we know the only other components of expired air that could have any effect in enhancing the virulence of the bacillus are the carbonic acid, the aqueous vapour and the organic matter that it contains in excess. But all these substances must be present under the circumstances already spoken of, in which there is yet no direct transference of the disease. How, then, can these facts be reconciled with the overwhelming evidence that air rendered foul by respiration is one of the most powerful agents in producing consumption.

The explanation given by Dr. Koch is (1) the need for some

preliminary injury to the lungs in persons who are about to act the part of hosts to these parasitic organisms, some denudation of the mucous membrane of the lungs, or some injury to the elasticity of these organs; and (2) the need of a plentiful supply of the infecting material.

The number of these microbes contained in the breath, even in advanced cases of phthisis is, as I can testify from repeated examinations, exceedingly small; but, on the other hand, the dried sputum from such patients contains them in enormous quantities. "This sputum is not only ejected directly on to the floor, there to be dried up, to be pulverised, and to rise again in the form of dust, but a good deal of it dries on bed linen, articles of clothing, and especially pocket-handkerchiefs. which even the cleanliest of patients cannot help soiling with the dangerous infective material when wiping the mouth after expectoration; and this also is subsequently scattered as dust."

I am doubtful myself how far this explanation would account for the exemption of the attendants of consumption hospitals from disease, and still more for the immunity conferred by residence upon well-drained porous soils.

It affords no reason for the diminution in the phthisis rate of Salisbury, for instance, by one-half, after the introduction of proper drainage, and I am therefore inclined to believe that we have still not attained to a complete knowledge of the natural history of the microbe, and to venture the hypothesis that it may gain in virulence by a short sojourn outside the body, in the presence of organic compounds favourable to its existence, and contained either in impure ground air or else in air rendered foul by respiration; experiments need to be made on this point.

In this case the bacillus of tubercle would fall into the same category as the microbe of enteric fever and cholera, and whilst scarcely at all infective from person to person, it would gain the power of reproducing the disease by a sojourn for a shorter or longer time in some medium favourable to its development. If high temperatures are absolutely needed for its existence I am inclined to think that it would find them in some nook or corner in the common kitchens and living rooms inhabited by many of the poor inhabitants of our towns.

It is possible that all the components of expired air except the oxygen may take part in sustaining the existence of the microbe. I do not know whether the action upon it of carbonic acid has yet been ascertained, but it seems probable, from its continued existence in decomposing fluids, that it is one of those bacilli whose life is fostered by this vapour. We can see at once also that aqueous vapours charged with organic matter would be eminently fitted to sustain its existence. The nature

of the organic matter contained in the breath is not yet fully ascertained; it is probably partly gaseous and partly solid. I have myself examined it microscopically in a good many cases, both in health and disease, and have ascertained the quantity exhaled under various conditions. It certainly contains numerous solid particles; some of it simply disintegrated organised material, some dried up epithelial scales, and in some diseases, as in measles and whooping cough and phthisis, the specific organisms of the disease.

Its quantity is indeed very small, I found that only about 0·2 of a gramme is excreted per diem by healthy adults, or 0·4 gramme per metre of expired air, but this is 500 times as much as Dr. de Chaumont found in the outer air, and when condensed upon solid bodies it often forms a perceptible foully smelling film, and we know further from Dr. Hammond's experiments that it is virulently poisonous, and it would probably sustain the life of the bacillus, though I am not aware of any direct experiments on this point.

We are now in a position to state the measures that are needed for the prevention of this terrible scourge of our population, and they may be thus briefly enumerated.

1. As far as possible the disinfection or destruction of the phthisical expectoration.

2. The discouragement of marriage between phthisical individuals.

3. The prevention of irritating dusts in workshops, or at any rate the adoption of means for sweeping them away from the mouths of workpeople, as is now almost universally done in the workshops of Sheffield.

4. The discouragement of stooping or confined postures during labour.

5. The better drainage of impervious soils, and the cleansing away of all kinds of filth.

6. The provision of thorough ventilation by night and day, not only in workshops, offices, warehouses, and factories, but also in the dwellings of both rich and poor, and in the streets and crowded alleys in which they live.

By the adoption of some such means as these I firmly believe that, in the course of time, we should see the present frightful mortality from consumption greatly diminished, and although they could probably be only partially carried out, every effort in the right direction would be rewarded by some improvement in the death-rate, not only from consumption, but also from other diseases, and especially diseases of the lungs.

CLEANLINESS.

AN ADDRESS TO THE WORKING CLASSES.

By Major Lamorock Flower,

Sanitary Engineer to the Lee Conservancy Board, &c.

"If I wash thee not thou hast no part with me"—so spake the greatest of all teachers, and with humble reverence will I endeavour to draw from *His* teachings the lesson which I trust the working classes of this important and prosperous town may learn from the Congress of the Sanitary Institute.

Cleanliness is a subject which opens up ideas of almost illimitable magnitude. It is practically the very mainspring of our existence. It is spoken of as being "next to goodliness," or as some put it, "next to godliness"—cleanliness both without and within; and how many are the graces which surround the cleanly being? How great a moral did Sir Charles Napier point when in consultation as to the "articles" necessary to be taken by the men of his army on a campaign, he said, all that a man wanted in that way was "a bit of soap and a tooth brush?" He implied cleanliness of person to be the order of those under his command, and perhaps it may not be too great a straining of an inference to imply by the tooth-brush that those foul utterances which too often come from the mouth of man should not be.

The Great Duke of Wellington was a cleanly man. He is reported to have said his best officers were his greatest dandies, and he was wont to give a little lecture occasionally on a dirty button. Selecting some soldier from the ranks, who had probably "skipped" a button from his polishing performance, he would say, "The second (or otherwise) button on your coat, my man, is dirty; and what is the consequence? You are a dirty

man; the company to which you belong is dirty; the battalion is dirty; the brigade is dirty; the division in which you are is dirty. Egad! the whole British Army is dirty on account of that dirty button."

Now what did all this imply but cleanliness necessary to well-being; and attention to even the smallest detail was not beneath the touch of his master mind. Who can fully realise the value of attention to little things? A little thought will, however, make us fully appreciate its importance. Sands make the mountain, moments make the year; nothing is too small or too insignificant to be overlooked. We all have our little corners to fill in the great scheme of life. A great painter, eminent for attention to small matters, said that looking to trifles made perfection, and that perfection was no trifle; and He of whom I spoke in commencing this address, said "even the very hairs of your head are all numbered." Cleanliness in dress—dress suitable to station—is again an important point. Shakespeare said, "The apparel oft proclaims the man," and how true is this. What a sad sight it is to see a good British workman about in rags and tatters, slouching along—it may be as the Scotchmen say, "a bit fou" into the bargain. Such a sight always seems to point to that curse, a want of order. Order is Heaven's first law. The cleanly person is a creature of order; we never find a disorderly person smart and cleanly, nor do we ever see a slovenly uncleanly person orderly. How invaluable is that man or woman to those who employ them who bring order and cleanliness into their daily duty; method is at the root of all their actions, and out of method comes punctuality, for "Method is the very hinge of business, and there is no method without punctuality."

Cleanliness in the home. "Home! there's a magic in the word;" and how do not we working men—for I claim to be a working man as much as any of you—how do not we rejoice in a cleanly home, a refuge after the toils of the day, the remembrance of which lightens our daily task and makes the work go all the easier? and what joyous homes may we not have where cleanliness "rules the roost?" How much lies in the brightly polished metal, the bright blackened stove, the clean swept hearth, the bright, clean window-pane; the window-sill, it may be, decked with a few flowers, fit emblems of a bright place within? And how easy is all this of attainment. The late Sir Joseph Paxton, the great gardener, thus wrote on window gardening:—"The cultivation of flowers is of all amusements of mankind the one to be selected and approved as the most innocent in itself and most perfectly devoid of injury or annoyance to others. The employment is not only conducive

to health and peace of mind, but probably more good-will has arisen and friendships been founded by the intercourse and communication connected with this pursuit than any other. The pleasures arising from the culture of flowers are harmless and pure; a streak, a tint, a shade, becomes a triumph which, though often obtained by a chance, is secured alone by morning care, by evening caution, and the vigilance of days. It is an employ which, in its various grades, excludes neither the opulent nor the indigent, teems with boundless variety, and affords an unceasing excitement to emulation without contention or ill will. There is no other pursuit alike calculated for peer and peasant in which the distinctions are so trivial; for the cottager may possess and enjoy the same beauteous rose or fragrant mignonette in his little plot or his window that occupies a place in the garden of the richest. There are few surer tests of a happy home within than the flower-decorated window and neat kept garden; and there is no occupation for the leisure hours more calculated to keep it so, or to soothe the mind. It yields pleasure without surfeit; the more we advance the more eager we become." A pleasant picture truly, and one which, methinks, is already realised in some homes in Bolton. The Great Teacher often drew his pictures from flowers, and the higher we grow in appreciation of order and cleanliness the more we shall love them. Lady Blessington beautifully writes:—

> "Flowers are the bright remembrancers of youth:
> They waft us back, with their bland, odorous breath,
> The joyous hours that only young life knows."

Let me, then, recommend to you window gardening as one of the evidences of cleanliness. Perhaps it may not be out of place here to note that, to quote Lord Albemarle, some years since he was attracted by a bright, pretty little girl, who seemed to take much pleasure in caring for and watering the flowers which grew under a certain window where he sat; it seemed to give that simple and becomingly dressed little lady infinite pleasure. Who was she? The Princess Victoria, now and for over fifty years our Queen.

I spoke just now of perfection; that should be the aim of all of us working men. What are the essentials of a good working man? A healthy body, born of cleanliness; a healthy mind, naturally following cleanly and orderly habits; a clear brain, following both. Aim at perfection, let this be your resolve:—

> "If I were a cobbler, it would be my pride
> The best of all cobblers to be;
> If I were a tinker, no tinker beside
> Should mend an old kettle like me."

I think, perhaps, I have said enough generally as to cleanliness, and in order to have that pleasant home we must have a healthy house. There are certain essentials to this condition. The house should not be damp, and to ensure this it must be built on a healthy site; proper provision must be made to prevent the damp rising up the walls, and the dampness of the earth rising through the floors; if the soil be damp a sufficient layer of concrete should cover the whole site. I do not intend to weary you by going through all the details of house building, and I will only speak generally. Another important point about a healthy home is that no impure matter should be allowed to accumulate in and about the building; there should not be any blind corners with the dust swept up into them to fester and decay; the ash pit or receptacle should be frequently emptied, daily if possible. How often do we hear of "death in the dust-bin?" The floors of rooms should be scrubbed at least once a week; in one word, freedom from every kind of impurity is an absolute necessity. Then there should be abundance of light in a healthy house; no dark corners, giving a chance for filth to accumulate unseen; besides, plenty of light makes a house more cheerful. There should also be a plentiful supply of wholesome water; care should be observed that the cistern which supplies the drinking water does not also directly supply the water-closet, if such a thing exists. We require water from the first moment of our existence, and it enters largely into all the compounds of our daily wants. It should be jealously cared for, and the cisterns or other places for its reception should be frequently thoroughly cleaned out. A very large number of "the ills our flesh is heir to" are due to the use of impure and improper water. Water, to be really wholesome, should be first boiled, then filtered through some one or other of the many media which are provided for this purpose. Plenty of soap and water and an efficient application of that useful commodity known as elbow grease will much tend to keeping up a healthy home. If it be possible, too, the water supplied to a house should be soft, not hard; cleanliness may then be more readily attained.

Again, plenty of fresh air should be supplied to a house. Ventilation is nothing more than air being constantly changed. Draughts are inexcusable, and by a proper arrangement of opening windows, air may be kept in motion without the inconvenience, annoyances, and danger of draughts. Care should be taken that the chimney flues are always open to assist in the circulation of air, and the pernicious practice, too commonly observed, of shutting down the flap of a register stove should be abolished. In the morning, on rising from bed, open all the

windows, turn down the beds, and leave them open to "the fresh air of incense-breathing morn," and not, as is too commonly the practice, keep the windows shut and make the beds as soon as the occupants have left the chamber. There ought not to be any "dead ends" to passages. Few can over-estimate the value of fresh air.

It is not always possible to have a bath room, but conveniences for personal cleanliness should be present; and anyone who is accustomed to the comfort of a good sound daily ablution of the whole of his body will never be without it.

Cleanliness in cooking is again a most important point. A good housewife will see that all her cooking appliances are kept in perfect order. There should be ample convenience for "washing up;" and here let me note one fruitful cause of disease—the discharge of sink washings direct to the cesspool drain, or sewer, without the intervention of a proper trap. All wastes from sinks, baths, and wash-up places should discharge into the open air over a properly trapped gully, and not, as is commonly, too commonly, the case, direct to the drain; the bell trap of the sink being taken up and put on one side thereof "to let the stuff away"—a favourite form of excuse.

I will not here go into the question of proper ventilation of sewers, or the efficient flushing thereof; but these are again important points in securing cleanliness. The recent almost tropical weather has shown us that sewer air escaping through the street ventilators is by no means pleasant, and many a person has been struck down by sickness from casually inhaling the foul air. It is quite possible to ameliorate this: I will not, however, on this occasion go into the question.

Sir John Simon says, "It is to cleanliness, ventilation and drainage, and the use of perfectly pure drinking water, that the population ought mainly to look for safety against nuisance and infection."

Some five-and-twenty years since, when Lord Palmerston was Prime Minister, we suffered from a fearful visitation of Asiatic cholera. It was called, and justly so called, a judgment of God. Yes, a judgment on those who neglect cleanliness in its widest sense, on those who allowed the filth of our towns to accumulate and ferment in cesspools, foul ditches, bad sewers, dust-bins, and such like. It was proposed to the Prime Minister that a national fast day should be appointed, and that by direct intervention of the Almighty, the evil might be removed or alleviated. At the risk of much adverse criticism he refused to entertain the request. He told people instead to turn to the work of sanitary reform, to whitewash their houses, and to clear away their filth.

An old classic fable tells us how a carter, unable to get his vehicle up a hill, implored Jupiter for help, and the carter was told first to put his own shoulder to the wheel. "God helps those who help themselves," is a well-known and well-appreciated legend.

Many condemned Lord Palmerston as being irreligious and flying in the face of Providence. But one at least of the clergy—that grand muscular Christian, Charles Kingsley—approved, and in these words publicly thanked His Lordship:

"As a clergyman I feel bound to express my gratitude to Lord Palmerston for having refused to allow a national fast day on the occasion of the present reappearance of pestilence, and so having prevented fresh scandal to Christianity, fresh excuses for the selfishness, laziness, and ignorance which produce pestilence, fresh turning men's minds away from the real causes of this present judgment to fanciful and superstitious ones. It was to be hoped that after the late discoveries of sanitary science, the clergy of all denominations would have felt it a sacred duty to go forth on a crusade against filth, and so to save the lives of thousands, not merely during the presence of cholera, but every year."

Cleanliness is a positive necessity, and I trust that some good may follow from this our Congress at Bolton. I am but trying to teach that doctrine which was impressed upon the Israelites of old by that first great sanitarian, Moses, and which, as I before said, lies at the root of all our well being. Cleanliness of ourselves, and of our dwellings and our surroundings, is imperative upon us as one of our duties to our neighbour—not the least of our obligations. "Wash and be clean" was a divine command. This is Saturday night, and I must not trench upon the province of those who teach in your various places of public worship. I merely wish to draw a moral from the teachings of One who "went about doing good," and I think you will have no difficulty in realising what that moral is.

Cleanliness is next to godliness, and where cleanliness fails, absence of godliness soon follows.

I cannot do better than close this address in the words of the Great Teacher with which I opened it—"If I wash thee not thou hast no part with me."

SELF-HELP.

AN ADDRESS TO THE WORKING CLASSES.

By A. Wynter Blyth, M.R.C.S., L.S.A.

In the South of France there were two neighbouring vineyards: in the one, the property of Alphonse, the vines were sickly and diseased; in the other, the property of Peter, the rich grapes hung in heavy clusters amid green untainted leaves.

Said Alphonse to Peter: "How is it the blight has not touched your vines?"

Peter replied: "I have sulphured them."

"Sulphured them!" rejoined Alphonse; "so have I."

"Did you do it yourself?"

"Myself! No; have I not labourers?"

"Ah!" cried Peter triumphantly, "there is the reason: I put my own hands to the work, then I was sure it was done and done well."

Self-help, my fellow workers, is the title of my address: self-help in the preservation of your own health and in that of your families.

Much has been done for every one in this country: laws of a beneficent character have been passed, enforcing the removal of the more evident injurious conditions; in most places there are hospitals for the infectious sick; there are elaborate systems of drainage and water supply. But from all these the people themselves will never reap the full benefit unless each individual in his sphere, be it small or great, adopts as the rule of conduct the principle of self-help. This principle of self-help may be developed especially in three directions:—

Self-help in the home.
Self-help in daily work.
Combined or organised self-help.

Self-help in the home.—Self-help begins in the selection of a home. A man has generally some kind of choice. If a dwelling,

on account of some serious defect of structure or position, lets at a cheap money rent, it is a dear bargain and you are best quit of it. In the selection of the place where you are to live always make good use of three inspectors of nuisances—your two eyes and nose; look out for signs of rats—rats as a rule mean bad drains; examine the basement and see the course of the soil-pipes, sink-pipes, and waste-water pipes, and whether the two latter discharge, as they ought, in the open over a trapped gully; look yourselves to all the traps, light a bit of paper and see if there is an up-draught; more especially dread dampness, as evidenced by stains on the walls; be very suspicious of match-boarding in a basement—match-boarding in nine cases out of ten is to conceal not to remedy dampness. Of all the definite nuisances to health, dampness is the one concerning which the proof of its insanitary character is the most abundant. Any obvious nuisance must be at once removed: do not wait on the leisure of others, do it yourself if you can.

Two families, Dawdle and Spry, living in the same quarter, had their drains stopped up and their basements flooded by the violent thunderstorm which burst over the metropolis a few weeks back. Dawdle put his hands in his pockets and said: "It's the landlord's duty to unstop the drain; he is coming to-day for the rent; a good thing too, for the stink is enough to make us all ill."

But the landlord did not come that day, nor the next, and by the time the drain was unstopped Dawdle's family, including himself, were all seriously sick with bad sore throats.

Very different was the action of Spry; he came home from his work, saw the state of things, pulled off his coat, opened the drain, cleared the drain, washed the filth out of the basement, disinfected it with a few pennyworths of carbolic acid, and after a couple of hours' work his house was as sweet and clean as before the accident. Self-help again!

"It ain't my work to clean up this yard," says Sally.

"Nor mine neither," retorts Betty. So between the two the yard is left and the filth accumulates, to the discredit and injury of both. If the house was on fire, think you would these two wrangle as to who should fetch the water or fetch the fire-engine? Ah! preventable disease, disease preventable by our own efforts, is more destructive than fires or railway accidents, even though they be as terrible as the Exeter fire or the Doncaster collision.

Division of responsibility in sanitary matters is always wrong. It is essential in tenement houses that the tenants themselves come to a just agreement as to who should keep the yards, stairs, and passages, common to all, soiled by all, in a cleanly

state. I know hundreds of working men's dwellings where this arrangement is adopted, and the results are most creditable, and there are others where, from a want of mutual understanding, dirt is not the exception, but the rule.

In the home it is specially to women we look to show us what self-help can do. It is woman that makes our dull homes bright, with her kindly presence and attention to little details, trifling in themselves, but of immense importance in the aggregate. It is her instinct of self-help that adorns the windows with flowers, cleanses floors and walls, and has a place for everything and puts everything in its place.

On the woman lies the responsibility of rearing, feeding, and instructing the young. Not the least of her duties is that of preparing and cooking the food for the family. Now, in the matter of food, self-help allied to knowledge will prevent us being infected by our food, otherwise what should be nourishment becomes destruction. The most essential matter is to cook nearly everything eaten or drank, and to cook it well. It is the great discovery of modern times to have found that the infectious fevers are produced by small living particles called germs; they are very minute and quite invisible to the unaided sight, so small that they can hold a family party on the point of a needle; they belong to a large race, most of whom are perfectly harmless; those that cause disease are the wicked members of the community. Their tenacity to life is sometimes very considerable: some will stand the heat of boiling water for a brief time, but none will stand it long. Many foods and drinks may become infected with disease germs, but milk is specially liable to this infection; sometimes it becomes injurious from being derived from a diseased cow, sometimes from being contaminated by a diseased person. It has been fairly proved that consumption, scarlet fever, diphtheria, typhoid fever, ulcers in the mouth, and a few other maladies have arisen from taking infected milk. In all these cases the milk has been taken unboiled. There is no authentic case of injury from boiled milk; of course, milk infection is only occasional; large populations may take unboiled milk for a considerable period without injury, but the time will come when it shows itself as a dangerous fluid. The old lady looked under the bed for the burglar for twenty years and found him at last. No chemical test will distinguish healthy from diseased milk, therefore it is a golden rule to drink no unboiled milk, and for similar reasons the thorough cooking, or in biological language, the sterilisation, of meat and vegetables is most essential.

Self-help in daily work.—There is no trade, handiwork, or occupation whatever by which a man earns his bread but

what has some special dangers to his health. Open-air workers are liable to be struck by the hot summer sun or to be chilled by the winter's damp and cold. Indoor workers have specially to battle with all kinds of bad air, causing many maladies, chief of which in fatality and incidence is consumption. Consumption is a preventable disease; recent researches have shown it to be intimately connected with a little germ, a parasite, and it is believed that this germ adheres to minute particles of dust, and in this way gets entrance to the lungs with the dust. Consumption is one of those complaints the contagion of which the people have been carefully and erroneously taught not to believe in; there is no pretence at precaution. Healthy husbands sleep with consumptive wives; children play about in the sick room; what is coughed up from the chest is allowed to be spat anywhere, as for example on the floor of a workroom, where it may dry and get converted into dust and be breathed as dust. Experiments have been made with such dust, and it has been found to readily infect animals, giving them a disease of the lungs; so there is little doubt those who have consumptive relatives or friends should adopt themselves, and cause to be adopted simple precautions; such for instance, as at night the separation of the sick from the healthy, and the reception of what is spat up from the chest on to rags or paper, so that it can be burnt or otherwise destroyed. To return to dust, it has been found that mineral or metallic dust is more injurious than vegetable dust; but all kinds breathed day by day are a fertile cause of various and fatal chest complaints. Now, if any of you work in crowded dusty rooms, you can, if you choose to follow a bit of advice, always breathe dust-free air; the advice is breathe through your nose only, keep your mouth shut. You will find in this Exhibition a collection of very ingenious respirators, little pieces of apparatus which, by filtering the air through cotton wool, will deprive it of dust and smoke. But the cavity of the nose is the finest respirator ever invented; it is carpeted throughout with a living velvet pile, always moist, so as to catch and fix the little particles of dust: the mouth for speaking and eating, the nose for breathing. Breathing through the mouth is a bad habit; those of you who have got it, get out of it as soon as you can. As for other measures a workman should take to preserve his health, in their detail they are as various as the trades themselves, and must not to-night detain us. I therefore pass on to consider what can be done by

Combined self-help for health.—The working men of this country have combined, have co-operated for many purposes. You have co-operated to found great successful clubs like

the Oddfellows and Foresters' Societies, dealing and managing very ably with large sums of money; you have combined for political and social purposes; you have combined in strikes for higher rates of wages or to redress some grievance—why not combine for the purposes of health? and what better object, more conducive to health, is there than building yourselves healthy homes? Abolish landlordism—not by boycotting or shooting your landlords, not by refusal to pay rent or any other illegal way, but by becoming landlords yourselves, the owners of your own houses. It may be for the moment bad times, but these will pass; there are years when plums are scarce, and years when plums are plentiful; the good wife makes her jam in the plentiful years, the artisan can also make his jam in the plentiful years; the savings of ten men for five years might be enough to start building a row of small houses, or a block of houses whichever you choose; perhaps much would have to be borrowed, what matters? is it not better to pay interest and capital under the guise of rent, knowing that in a certain number of years the place will be your own, than pay rent which in the long run would buy the whole house twice over. Should you build your own houses, you will build them strong, healthy and convenient; none of the jerry building or house-grabbing structures. I hope there will come a time when the governing bodies of your cities will be told, we want no model dwellings built by either you or by speculators, we belong to the self-help gang, and will take all such matters into our own hands, and build them ourselves.

One last word: the leading rule in the social economy is that each man shall support himself; to do that he must have health and maintain health, and no trouble, no temperance, no exercise should be spared to that end. Preventive medicine is democratic; it is not alone for princes or for the wealthy, it is for the people; and the more the people know of the causes of illness, the more will the efforts of those who have made hygiene their special study be appreciated and assisted. Without the confidence, without the assistance of the people, we sanitarians can do but little—the full benefits of sanitary science will only be received when you help yourselves and take advantage of the work that has been done, the knowledge that has been acquired.

THRIFT.

AN ADDRESS TO THE WORKING CLASSES.

By Henry Law, M.Inst.C.E.

Fellow working men, for I claim to be a working man in as real and full a sense as any one of you who are here present to-night, and I know of no title more honourable or more to be desired than that of a working man.

A recent writer, speaking of working men, has remarked—"They belong to the ancient and honourable family of workers—that extensive family which constitutes the backbone of our country's greatness—the common working people of England."

The real measure of the worth of a man is not the social rank which he may hold—does not depend upon the number of generations through which he can trace his descent, or how many of his ancestors have been known to fame, or as the possessors of wealth; but it is—What has that man done in his own person and life to promote the welfare or the material progress of himself and his fellow men?

Assuming this as our gauge, we may confidently affirm that all men who have *attained* greatness have been working men; that is to say, men who have worked earnestly and continuously, either with their hands or their head, or with both, in that particular calling or occupation which the accident of birth or other circumstances may have assigned to them. And we may further assert that in a very great majority of cases the greatest men, and those who have proved the greatest benefactors to their fellow men, those to whom we owe some of the most important and useful inventions, have risen from the humblest ranks of working men.

The time allotted me this evening would not suffice to allow of my giving you the names of even a tithe of those men, who, born in the most humble ranks of life, have attained to greatness and

become the benefactors of their fellow men; amongst those, however, whose names will be most familiar to you I may mention the following, namely: George Stephenson, who rose from being a cowboy earning twopence a day, and became the father of the locomotive and of the existing system of railways; Thomas Telford, who rose from being a shepherd, to become one of the most noted engineers, the constructor of the Menai suspension bridge, and many other important works, and was the founder and first President of the Institution of Civil Engineers; James Brindley, who from an ordinary labourer, became the engineer of the Bridgewater canal and many other important engineering works; Sir Richard Arkwright, a name specially to be honoured in Bolton, who rose from being a barber, to make the most important improvements in the machinery for the manufacture of cotton goods; Samuel Crompton, another Bolton man, whose father was a small farmer, and who was the inventor of the spinning-mule; Robert Hawthorne, the father of the well-known Newcastle engineer, who was originally engineer at the same colliery at Dewley, at which George Stephenson was fireman; Michael Faraday, the chemist, who was a bookbinder's apprentice; Sir Isaac Newton, who was the son of a widow with an income of only £80 per year; Sir Humphrey Davy, who was an apothecary's apprentice; Turner, the well-known painter, who was originally a barber; George Bidder, the well-known engineer, who possessed such extraordinary powers of calculation, and was the son of a stonemason; Jesse Hartley, for many years the engineer of the Liverpool docks, who was a working mason; Shakespeare, Burns, Ben Jonson, Cook the navigator, Hugh Miller the geologist, the first Sir Robert Peel, Jacquard, the inventor of the loom which bears his name; Bunyan, the author of the Pilgrim's Progress, Newcomen, the improver of the steam engine, Chantrey the sculptor, Sir Thomas Lawrence the painter, Richard Cobden, Flaxman the Sculptor, Dr. Livingstone the African traveller, Gainsborough the painter, John Dalton, Sir William Herschel the astronomer, and many other eminent men, who want of time forbids me to mention, all rose from the most humble ranks of life.

It may be confidently said that nearly all the most important and useful discoveries and inventions have been made by those who have risen from the more humble ranks of working men. Smiles, in his life of George Stephenson, remarks,—"It is certainly a striking and remarkable fact that nearly all that has been done for the improvement of the steam engine has been accomplished, not by philosophers and scientific men, but by labourers, mechanics, and enginemen. The steam engine was but a mere toy until it was taken in hand by workmen.

Savery was originally a working miner, Newcomen a blacksmith, and his partner Cawley a glazier. In the hands of Watt, the instrument maker, who devoted almost a life to the subject, the condensing engine acquired gigantic strength; and George Stephenson, the colliery engineman, was certainly not the least of those who have assisted to bring the high-pressure engine to its present power."

It may, I think, without fear of contradiction be said, that we owe our greatness as a nation chiefly, if not entirely, to the labours of our working men.

Such being the case, it becomes an interesting and profitable subject for enquiry to ascertain what are those peculiar qualities in our working men which have led, in so many instances, to the attainment of such strikingly successful results, and I hope to be able to convince you that those qualities may be shown to be summed-up and expressed by the one word, THRIFT.

Now, "thrift" is derived from the verb to "thrive," and to thrive from the Icelandic word *throa*, to increase, and, according to Johnson, "thrift" means "profit, gain, riches gotten, state of prospering," while the verb to "thrive" means to "increase, prosper, grow rich, advance in anything desired."

I dare say, on first hearing the word thrift, your thoughts turned to the subject of money, and you associated with the word the saving of money; but I desire this evening to direct your attention, not so much to thrift as regards money, but rather as applied to thrift of time and health, both of which, however, mean gain of money and material wealth.

Now, while thrift of money means frugality, economy, and care in making investments, thrift of time means industry, perseverance, and punctuality, and thrift of health means that taking care of our bodies which leads to the maintenance of health, energy, and unimpaired powers, both of mind and body.

These are the qualities which lead to success in life, and enable working men to attain to the position of eminence and usefulness of which I have cited a few examples. This fact was expressed by Mr. Bright in addressing an assembly of working men at Rochdale just forty years ago, when he said: "There is only one way that is safe for any man, or any number of men, by which they can maintain their present position if it be a good one, or raise themselves above it if it be a bad one, that is, by the practice of the virtues of industry, frugality, temperance, and honesty. There is no royal road by which men can raise themselves from a position which they feel to be uncomfortable and unsatisfactory as regards their mental or physical condition, except by the practice of those virtues by

which they find numbers amongst them are continually advancing and bettering themselves."

The more you study the careers of such of these eminent men who have risen from the ranks of labouring men as have had their lives published, the more convinced you will become of the truth of the foregoing statements. If, for example, we take the career of George Stephenson, we find it marked by the utmost frugality, industry, and the devotion of all his leisure time to the acquirements of a knowledge of reading, writing, and mechanics, and we find him constantly engaged in athletic sports, presenting a remarkable instance of thrift of money, time, and health.

The early career of the firm of Yates, Peel, & Co., of which the first Sir Robert Peel and his father-in-law were the founders, exhibits the same striking instance of thrift. Smiles, in his "Self-Help," narrates as follows:—"The frugal style in which the partners lived may be inferred from the following incident in their early career. William Yates being a married man with a family, commenced housekeeping on a small scale, and to oblige Peel, who was single, he agreed to take him as a lodger. The sum which the latter first paid for board and lodging was only eight shillings a week, but Yates, considering this too little, insisted on the weekly payment being increased a shilling, to which Peel at first demurred, and a difference between the partners took place, which was eventually compromised by the lodger paying an advance of sixpence a week."

Passing, however, from the subject of the thrift of money to that of time, it is impossible to overrate the importance of the latter. I have already remarked that thrift of time involves industry, perseverance, and punctuality. Industry, not only during the hours given to the daily work, the necessity and importance of which is the character and reputation which it secures to the working man of an honest desire to faithfully perform his duty; but what I more especially refer to as the thrift of time is the habit of devoting those leisure moments, which must occur in the busiest man's daily life, to some useful purpose. Young has termed the leisure moments which occur in daily life the "gold-dust of time," and such they truly are. There is a well known anecdote of the great naturalist Buffon, which illustrates this subject. Constitutionally he was of an indolent disposition, but he formed the resolution to rise early in order to prosecute his great work on natural history. Finding, however, that the attraction of his bed was stronger than his resolution, he directed his servant Joseph to compel him to rise, promising him half-a-crown for every time that he made him leave his bed before six o'clock, and this Joseph faithfully

did, notwithstanding the remonstrances and threats of his master of immediate dismissal, followed an hour or two after by the promised reward; and Buffon was accustomed to say that he owed to his servant Joseph three or four of the volumes of his work on natural history.

The importance of thrift of time will be appreciated when it is considered that lost time can never be recovered, it is irrevocably gone for ever, and no subsequent regret can ever recall it; lost money may be recovered, even lost health may sometimes be restored, but lost time is a loss which no effort or exertion can ever replace. Such being the case, it behoves every man whose desire is to succeed in life to be specially careful to save the "gold-dust of time" which may fall to his share.

In Smiles' "Life of George Stephenson," he remarks: "Perhaps the secret of every man's best success in life is the readiness with which he takes advantage of opportunities. George Stephenson was an eminent illustration of this readiness in turning all his time to profit, and everything that he knew to useful account. Every spare minute was laid under contribution, either for the purpose of adding to his earnings or to his knowledge. The smallest fragments of his time were regarded by him as precious; and he was never so happy as when improving them. He missed no opportunity of extending his observations, more especially in his own immediate department; he was always acquiring new facts, and aiming at improvements in his own calling. Sometimes he failed, but his very failures only served to strengthen his hardy nature, and they eventually conducted him to success."

Another most important practice of the thrift of time is the habit of observation and attention to passing circumstances and events. Hugh Miller, the well-known geologist, has truly observed: "That the training of the mechanic,—by the exercise which it gives to his observant faculties, from his daily dealing with things actual and practical, and the close experience of life which he acquires,—better fits him for picking his way along the journey of life, and is more favourable to his growth as a man, emphatically speaking, than the training afforded by any other condition."

Perseverance is clearly involved in the thrift of time, for nothing can be a more useless or extravagant waste of time than to engage in pursuits, and to abandon them, when only partly accomplished.

Punctuality is not only essential to the thrift of our own time, but is a duty we owe to our fellow men, as a want of punctuality occasions a loss of other people's time besides our own.

I pass on now to speak of the thrift of health, a subject the

importance of which it is impossible to overrate. For, not only will strict attention to sanitary principles prolong your lives, but it will render those lives better worth living for.

A very large proportion of you have to do with machinery, and to such it is not necessary to point out, how essential to the well working of every machine it is, that it should be kept constantly in good order, free from grit and dirt, properly oiled, and not put to heavier or rougher work than that for which it was designed; and in the case of a steam engine, the fires must be fed with a sufficient supply of proper fuel and fresh air, while the boiler must have a due supply of clean and pure water.

But the human body is a far more delicate machine than the most delicate piece of machinery ever constructed;—much more delicate even than the smallest and finest watch, and in order that the human body shall be capable of working to the greatest advantage,—to perform the greatest amount of work, of the best description, with the least wear and tear, the same care and attention must be bestowed upon it as is necessary in the case of every other machine; whilst to maintain the living power or energy, the human body must be supplied with a due amount of fresh and pure air, and be fed with a sufficient supply of wholesome and proper food.

As in the case of the steam engine: unless the fire is fed with sufficient fuel of good quality the engine will not work satisfactorily; so with the human body: strength and the power of vigorous action cannot be maintained without a due supply of food of good and wholesome quality.

As in the case of the engine: if the boiler becomes covered with deposit, and the moving parts clogged with grease and dirt, much power will be lost; so is it also with the human body: if through neglect and want of care and cleanliness the lungs and stomach become clogged from breathing bad air and consuming unwholesome food, or if the functions of the skin, so essential to perfect health, are checked through want of frequent washing and suitable clothing.

Again, as the engine will lose power unless the boiler, cylinder, and steam-pipes be kept warm by being lagged, or covered with some non-conducting material, and unless the condenser be kept cool, so will your health suffer unless the body be maintained at the proper temperature.

And, inasmuch as the mechanism of the human body is so much more delicate and intricate than the finest piece of machinery ever constructed, so is it more susceptible to injury and more affected by want of care and proper and constant attention.

The time allotted me is utterly inadequate to allow of my describing to you the mechanism of the human body, even were I competent to do so, which I am not, and I must therefore content myself with such a general sketch as will enable you to understand how essential to the health and well-being of men it is to attend to those sanitary precautions which constitute the thrift of health.

We may describe the human body as consisting of a framework of bone, termed the *skeleton*, jointed in various parts to allow of freedom of motion, and protected from injury by a covering of flesh, which constitutes the main substance of the body; throughout this substance are distributed cords, or *muscles*, which are so attached to the several bones as to produce movements in the several parts of the body by their contraction; in the head there is a central electric telegraph station, termed the *brain*, which transmits through a system of conductors, termed *nerves*, the desires of the individual to every part of the body, controlling and directing the action of the muscles, and the movements of the body.

Now the machines with which you are familiar are constructed at first of their full dimensions, being incapable of growth, only requiring at stated intervals, the renewal of such parts as have been worn or deteriorated by constant use. In the human machine, however, up to a certain age the whole structure increases in size or *grows*, requiring a constant addition of fresh materials to build up the various parts of the body to the increased dimensions. But, further, the materials composing the human body are not of a permanent character, but are always being gradually removed and replaced by fresh material, so that the whole substance of the human body, even to the bones, becomes changed once in about every seven years.

Now the machinery by which this change of material and growth of the body is produced, consists of an arrangement by means of which the food is subjected to a combined mechanical and chemical process termed *digestion*, by which the materials suitable for the renewal and building up of the several parts of the body are separated, and reduced to a liquid form, constituting the *blood*.

Then within the body is a very beautiful four-barrel pump, termed the *heart*, fitted with proper valves, and producing a pumping action by the alternate contraction and dilation of the barrels. By the action of two of the pump barrels the blood is distributed through a system of pipes, termed *arteries*, which traverse every part of the body, leaving on its way the material required for the renewal and growth of the body, and taking up the effete or worn out material which the former is meant to

replace. Another system of pipes, termed *veins*, receives and collects the blood which has thus been rendered impure, and return it through two main veins to the heart. The pure blood as it leaves the heart is bright red, while the impure blood returned to it is dark purple, and it is necessary, before it is again circulated through the body, that it should be restored to its original state of purity.

In order to effect this, the impure blood is conveyed to the second two pump barrels of the heart, and by them is pumped through two bags, termed *lungs*, in which it is brought into contact with air in a very finely divided state, and undergoes a process of slow combustion, by which the whole body is maintained at the temperature of about 98 degrees, which is marked upon our thermometers as *blood-heat;* and by this combustion the impurities are burnt up, forming carbonic acid gas, watery vapour, and ammonia, the purified blood being changed from a dark purple to bright red, and passing away to the heart to be again distributed throughout the body. But in order that this process of combustion may be efficiently carried on, it is necessary that the surface of the lungs should not become clogged with foreign matter.

Now, on an average, the heart makes 70 strokes per minute, discharging at each stroke about $1\frac{1}{2}$ ozs. of blood against a pressure of about $4\frac{1}{4}$ lbs. per square inch, and consuming an amount of energy in the 24 hours of 600 foot-tons, that is to say, 600 tons lifted to a height of one foot.

As mechanics, many of you know that a pump which has to force water through a considerable length of pipe, will not act satisfactorily without an air-vessel to equalise the flow, and in the human pumping machinery even this is provided for by the pipes being elastic, so that the pulsating motion of the heart is converted into a nearly uniform flow through the arteries and veins.

The air in the lungs having been deprived of a portion of its oxygen, and mixed with the products of combustion, namely, the carbonic acid and water, requires to be changed, and this is effected by the action termed *breathing*, which consists in the alternate expansion and contraction of the lungs produced by the action of the muscles on the chest. The quantity of air which is thus pumped into and out of the lungs of a grown-up person in 24 hours, varies from 400 cubic feet when no exertion is being made, to 900 cubic feet in the case of a hard-working labourer; and it has been calculated that the work which has to be performed by the muscles in the act of breathing amounts to 21 foot-tons in the 24 hours—that is equivalent to the lifting of a weight of 21 tons to a height of one foot.

Having thus described to you the nature of the machine which constitutes the human body, you will be the better able to understand the conditions which are necessary to maintain this machine in the best possible working order.

You will immediately perceive, that if no less than from 400 to 900 cubic feet of air are passed through the lungs daily, unless the air is pure and free from dust or other foreign matter, the lungs must become clogged and their efficient action be prevented; and thus you will understand the vast importance that the air which you breathe should be pure, and provided in sufficient quantity to avoid the same air being breathed over a second time.

Again, you will understand, that the blood must be supplied with sufficient food, containing in the proper proportions the various materials required to provide for the waste constantly taking place in the several parts of the human body.

Thus for each day, the bones will require for their renewal from half to one ounce of mineral matter, such as common salt, and phosphates of lime and magnesia; for the nourishing of the body generally we require from $2\frac{1}{2}$ to $4\frac{2}{3}$ ounces of nitrogenous or albuminous food, such as eggs, meat, cheese, milk, bread, peas, lentils, &c.; and for the production of muscular energy from 13 to $17\frac{1}{3}$ ounces of fat and carbonaceous food, such as butter, lard, suet, sugar, and the starch of wheat, potatoes, rice, peas, &c.; making a total of solid food, free from water, varying from 18 to 23 ounces, depending upon the greater or less muscular labour which the man has to perform.

Thus you will see, that in order to maintain the most perfect health, both the nature and quantity of the food should be varied, according to the occupation of each individual person, being increased in quantity, and especially in that of the carbonaceous food, as the person has to exert a greater or less amount of muscular energy—in other words, to perform more manual labour.

It may be taken that the total amount of energy absorbed by a living man, when in a comparative state of rest, is about 2500 foot-tons in the 24 hours, equivalent to a weight of 2500 tons being lifted to a height of one foot; and when engaged in performing an average amount of manual labour the energy exerted amounts to about 3900 foot-tons, equivalent to lifting 3900 tons to a height of one foot.

Now, I have never known a mechanic worthy of the name who did not take a pride in the engine or other machine entrusted to his care, bestowing all the attention possible to keeping it clean, bright, and in the best working order. Each one who I address to-night has been entrusted with a machine

far more perfect and beautiful in its design—far more delicate and intricate in its mechanism—than any machine constructed by human hands; and will you not take the same pride and exercise the same care, in keeping and maintaining the machine thus entrusted to you in the highest possible state of preservation, and rendering it capable of performing the largest possible amount of work of the best possible description? I feel confident that, as true working men, such is your desire, and since thrift leads to the attainment of that which we desire, let me commend to you the practice of thrift in every form—thrift of money, thrift of time, and thrift of health. Let it be your ambition, although only working men, to equal in real worth the highest in rank of your fellows; let your constant desire be the possession of a wise head, a pure heart, and a sound body.

CLOSING GENERAL MEETING OF THE CONGRESS.

The Closing General Meeting of the Congress was held on the afternoon of Friday, September 23rd, at the close of the Sectional Meetings. His Worship the Mayor of Bolton took the Chair, supported by the members of the Local Committee, and the Chairman and Council of the Institute.

Votes of thanks were passed to the President, the Local Committee, the Judges, and others who had been engaged in the work of the Congress and Exhibition.

The following reports upon the subjects brought forward for consideration at the Sectional Meetings were read by the Senior Secretaries of the respective Sections.

Section I.—SANITARY SCIENCE AND PREVENTIVE MEDICINE.

I have the honour to report that the President of Section I., Professor Russell Reynolds, opened the Section by a scientific, practical, and comprehensive address upon the extent of Present Knowledge in the Control of Human Diseases. The Medical Officer of Health of this Borough, Mr. E. Sergeant, placed before the Section the Records of the last ten years' advance in Sanitation in Bolton, and Dr. Livy traced the History of the Progress of Public Health. Dr. Alfred Carpenter introduced to the Section the Public Health Reports of Sir John Simon, in two volumes, and drew the attention of sanitarians to the works of "Our Pioneers" in sanitation, published by this Institute, of which the Vital Statistics of Dr. Farr was the first. The Right Hon. Lord Basing, President of the Congress, seconded by Dr. Tatham, Medical Officer of Health for Salford, proposed "That this Section, having heard Dr. Carpenter's address on the publication of the Reports of Dr. Farr and Sir John Simon by the Council of this Institute, recommend to the Council that there are many other medical essays on sanitary subjects which at present are only to be found in the Blue Books of the Privy Council and the Local Government Board; the publication of which, in an accessible form by the Sanitary Institute, would very much further the progress of sanitary science and practice." This resolution was carried *nemine contradicente*, about eighty members being present. Dr. McKeown then read a paper on the Prevention of Blindness. Mr. R. E. Middleton's paper

upon the Sanitary Registration of Buildings Bill being taken as read, for want of time, the labours of the Section were successfully brought to a close.

JOHN F. J. SYKES,
Honorary Secretary.

CONFERENCE OF MEDICAL OFFICERS OF HEALTH.

At the Conference of Medical Officers of Health, Professor Corfield, the President, opened proceedings by calling attention to the important position and growing responsibilities of Medical Officers of Health, and their established fitness to be charged with the control of the sanitary condition of dwellings and their surroundings. Dr. Vacher read an important paper on Death-causes and their Classification, and the President of the Congress expressed the opinion that some reform was necessary in the method of ascertaining the causes of deaths in doubtful cases. Dr. Armstrong, of Newcastle, seconded by Dr. Tatham, of Salford, one of the Vice-Presidents, proposed "That the Council of the Institute be recommended to consider the desirability of the Medical Officer of Health acting in the capacity of Assessor to the Coroner in all cases of death in which there has been no medical attendant, or none from whom a certificate of death can be obtained; and that in such capacity it should be the duty of the Medical Officer of Health to make full inquiry into all cases of suspicious or uncertified deaths." This resolution was carried *nemine contradicente;* from twenty to twenty-five persons being present. Dr. Kenyon raised an interesting discussion upon the provision of isolation for infectious cases.

Dr. Stopford Taylor read an account of the work of the Port Sanitary Authority of Liverpool, demonstrating the futility of the old system of quarantine and the value of the present English system of inspection and isolation. A paper upon the Supervision of Dairies, Cowsheds, and Milkshops, read by the Honorary Secretary, raised an interesting discussion, which elicited the opinion that nothing short of the *general* notification of infectious disease would suffice for the protection of milk from infection. Dr. Hope gave an account of the fearful amount of typhus fever that prevailed in Liverpool where no notification of disease takes place, and where typhus commits its ravages uncontrolled: hundreds of cases occurring every year. Dr. North, of York, one of the Vice-Presidents, seconded by the Honorary Secretary, proposed "That this meeting wishes to direct the attention of the Council of the Institute to the desirability of rendering the Conference of Medical Officers of Health (held for the first time at York) a permanent feature of the Annual Congress of the Sanitary Institute." This resolution was carried *nemine contradicente*, about a dozen persons being present; and I strongly recommend the Council to adopt the course suggested. This Conference was most successful.

JOHN F. J. SYKES,
Honorary Secretary.

SECTION II.—ENGINEERING AND ARCHITECTURE.

I have the honour to report that No. II. Section was opened by an able address by Thomas Hayter Lewis, F.S.A., President of the Section, upon the "*Sanitary Planning of Towns and Villages*," during which he satisfactorily demonstrated the right way of laying out streets in the near neighbourhood of a station, which had been most inappropriately planned and executed in a given instance.

Thanks were voted to the President for his interesting and useful address, proposed by Lord Basing and seconded by R. K. Freeman, F.R.I.B.A.

Mr. J. J. Bradshaw, F.R.I.B.A., of Bolton, read the first paper, on a subject recommended by the Council, viz., "*The Sanitary Condition of Cotton Factories*." Mr. Bradshaw, in an eminently practical way, entered fully into the details of the construction, heating, and ventilation of such buildings; his own experience as an architect having specially fitted him for so doing.

The discussion was opened by the Chairman, and continued by Messrs. Robins, Eccles, Professor Robinson, Leach, Simmons, Norbury, Honeyman, Field, Nanson, Connolly, Fletcher, Darley, and Sergeant. Mr. Bradshaw briefly replied.

Mr. S. H. Terry then read a paper on "*The Water Supply of Villages*," which was followed by another paper by Mr. Robert Sutcliff on "*Artesian Wells and Water Supply*."

Both papers were clearly and concisely written; the former being valuable as showing the small cost at which wholesome water might be supplied to villages.

The discussion of both papers followed. Mr. Rogers Field drew special attention to the use of windmills in raising water, and gave some valuable hints as to the mode of testing their working power, and as to the storage capacity of reservoirs dependent on windmill pumping for their water supply.

Messrs. Henry Law, Bradshaw, and Page followed; the latter seeking further information as to the purification and storage of rain water, in which he was supported by the President; Messrs. Railston Brown and Eccles continued the discussion.

Major Lamorock Flower then read a lively paper on the "*Fouling of Streams*." An animated discussion followed, in which Messrs. Law, Bradshaw, Dr. Carpenter, Rogers Field, Wilkinson, and Macassey took part.

The various means of depositing and utilizing sewage were considered, and the good and evil of sewage farms and surface irrigation were discussed.

Major Flower replied, and insisted on the importance of making each manufacturer deal with his own refuse.

Mr. Reginald E. Middleton then read a paper on "*House Drainage*," and urged the more efficient ventilation of public sewers and the carrying out of the axioms upon which all sanitarians agree in regard to house drainage, as contained in the report of the Civil and Mechanical Engineers' Society, which formed the basis of the paper.

Mr. John Honeyman, of Glasgow, next read a paper on "*The Size of House Drains and the Use and Misuse of Traps.*" This was a very original paper, and proceeded on the principle that the air-space in drains is usually insufficient, and should be increased on a plan of his own.

The discussions on these two papers were taken together; Messrs. Emptage, Rogers Field, Corbett, Robins, and Wilkinson took part.

Mr. Newton, Weybridge, took the opportunity, before Mr. Honeyman replied, to explain his own views in opposition to Mr. Honeyman's; and broadly stated that air should be excluded from fouled water by making arrangements so that the pipes should always be full and overflowing.

The next paper was by Mr. Corbett, on "*Health, Comfort, and Economy in Cottage Construction,*" which provoked considerable benevolent interest; the discussion was carried on by the President, Mr. Bradshaw, Canon Atkinson, and Mr. Coles.

The subject of *Smoke Abatement* was then taken up by the reading of three exhaustive papers by Messrs. Fletcher, Duncan, and Orvis, respectively; the discussion which followed was opened by Mr. Coles, and continued by Messrs. Head, Col. Winder, Howatson, Nicholson, Darley, Leach, Freeman, Lee, Wilkinson, and Scott.

The Chairman, in winding up the debate, remarked that they had not left the debate where they had found it, because an important recommendation had been forwarded to the Council of the Institute that they should appoint a committee to investigate and report on rival claims, and recommend such appliances as were found to be most suitable.

Two valuable contributions to the literature of the subject were put in by the veteran sanitarian, Edwin Chadwick, viz., one on "*Sanitary Sewage and Water Supply,*" the other on "*The Sanitary Condition of Water Supplies.*"

The proceedings of Section II. then terminated.

EDWARD COOKWORTHY ROBINS,
Honorary Secretary.

Section III.—CHEMISTRY, METEOROLOGY, AND GEOLOGY.

Section III. met in the Council Chamber of the Town Hall, Bolton, at 10.30 a.m., on Friday, 23rd September, and Mr. Rogers Field, Vice-Chairman of the Council of the Institute, introduced Dr. August Dupré, F.R.S., as President of the Section.

Dr. Dupré then delivered an interesting address, dealing generally with the Chemistry of Water and Sewage; entering into a consideration of the pollution of Water Supplies, and of some of the methods

in use for the detection and estimation of such pollution. He advocated the collection of standards in respect of certain constituents of water, for different districts; and made several valuable remarks in connection with the treatment of sewage.

The President's address was listened to with much attention by a fairly good audience.

On the motion of Mr. Rogers Field, seconded by Mr. Gass, a vote of thanks to Dr. Dupré for his address was unanimously carried.

Dr. Percy Frankland read a paper on "The Application of Bacteriology to questions relating to Water Supply." The author dealt more especially with the value, from a sanitary point of view, of the estimation of the number of micro-organisms of all kinds in water, as compared with the detection of pathogenic organisms.

Dr. Louis Parkes read an able paper on Water Analysis, in which a number of important points were raised.

A discussion on both these papers took place, in which Dr. Alfred Carpenter, Messrs. De Rance, Pendlebury, Macassey, Dr. Dupré (President), and Mr. Cassal (Hon. Sec.) took part. Drs. Frankland and Parkes having replied, Mr. J. S. Haldane read a striking paper on "The Sources and Hygienic Significance of the Impurities of the Air of Buildings and Sewers." The paper was illustrated by several tables of results. In the discussion which ensued, Dr. Parkes, Dr. J. Martin, Dr. Carnelly, Dr. Dupré (President), and Mr. Haldane took part.

Mr. C. E. De Rance read a paper on "Underground Water Supplies." Several points of local interest and general importance were very ably dealt with in this paper. The following gentlemen took part in the discussion: Mr. Eccles, Mr. H. Crook, of Manchester, Mr. Tiddeman (Vice-President), and Dr. Dupré (President). Some valuable observations on the papers of Messrs. Haldane and De Rance were contributed by Mr. E. Chadwick, C.B., who regretted his inability to attend.

The discussions on the papers of Drs. Frankland and Parkes and of Messrs. Haldane and De Rance, would have been much longer had time permitted; a far greater number of points having been raised than could possibly be dealt with in the time.

The time for closing the meeting having arrived, the President announced that the papers of Messrs. J. Collins and G. S. Jones were taken as read. The Vicar of Bolton proposed a vote of thanks to Dr. Dupré for his conduct in the Presidential chair of the Section: this was seconded by Mr. Henry Law, and carried unanimously, and the work of the Section terminated.

CHARLES E. CASSAL,

Honorary Secretary.

REPORT OF THE JUDGES OF THE EXHIBITION, BOLTON, 1887.

We, the undersigned, the Judges appointed by the Council, beg leave to recommend to the Council the following distribution of Medals and Special Certificates, and of Certificates of Merit.

Exhibits which have already received Medals at the previous Exhibitions of the Institute are excluded from awards of Medals, but those Exhibits to which a second Medal would otherwise be awarded receive Special Certificates, and these are distinguished in the following list by asterisks.

MEDALS AND SPECIAL CERTIFICATES.

CLASS I.—CONSTRUCTION AND MACHINERY.

* DOULTON & Co., *Lambeth*, for Peto Fireproof Flooring.
FOX, W., *Leeds*, for Corrugated Steel Tyre.
* GREENALL & Co., *Manchester*, for Steam Washer.
MANLOVE, ALLIOTT, FRYER & Co., *Nottingham*, for Johnston's Dryer.
ROTHWELL, W., *Bolton*, for Power Knitting Machinery.

CLASS II.—SEWERAGE AND WATER SUPPLY.

* DOULTON & Co., *Lambeth*, for Self-adjusting Joint for Stoneware Pipes.
* HEAP'S DRY CLOSET Co., *Manchester*, for Dry Earth Closet without Separator.
INTERNATIONAL WATER AND SEWAGE PURIFICATION Co., *London*, for Material for Filtering Water.
* MORRELL'S SANITARY COMPANY, *Manchester*, for Morrell's Cinder Sifting Ash Closet.
* WHITE, W. P., & Co., *London*, for Nicholls's Soot and Salt Closet.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

BENNIS, E., *Bolton*, for Smoke Preventing Mechanical Stoker and Camel Furnace.
ELLIOTT, EDMINSON & OLNEY, *Manchester*, for Welsbach's Incandescent Gas Burner.
* KIRKHAM, J. & W., *Bolton*, for the Blackman Air Propeller.
VICARS, T. & T., *Liverpool and London*, for Mechanical Smoke Preventing Stoker and Furnace.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

Burroughs, Wellcome & Co., *London*, for Digestive Ferments and Invalid Food Preparations.

* Constantine Bros., *Bolton*, for Jaeger's Sanitary Clothing.

Galloway, J., *Bolton*, for Plant for Aërating Mineral Waters.

Haslam, Lewis, *Bolton*, for Kershaw's Cellular Cotton Fabric.

A Magnetic Filter Company, *London*, for Spencer's Magnetic Filter.

* Manlove, Alliott, Fryer & Co., *Nottingham*, for Washington Lyon's Steam Disinfector.

Taylor's Cabinet Making and Upholstery Warehouse, *Bolton*, for Chorlton's Invalid Iron Bedstead with Wire Mattress.

CLASS V.—MISCELLANEOUS ARTICLES OF SANITARY INTEREST NOT INCLUDED IN THE ABOVE CLASSES.

Galloway, J., *Bolton*, for "Lightning" Fire Extincteur.

Haslam, J., *Bolton*, for "Reality" Hand Fire Extincteur.

Lovibond, J. W., *Salisbury*, for Tintometer.

CERTIFICATES OF MERIT.

CLASS I.—CONSTRUCTION AND MACHINERY.

Galloway, J., *Bolton*, for Gun Metal Boiler Fittings.

Galloway, J., *Bolton*, for Sight Feed Lubricator.

Gregson, J., *Bolton*, for Removable Rain-water Pipe.

Hembry & Co., *Manchester and London*, for "Through-colour" Linoleum.

Hindle, Norton & Co., *Oldham*, for "Acme" Door-Check and Spring.

A Sanitary Dry Lime Co., *Bootle*, for Sanitary Dry Lime.

B Thompson, H., & Co., *London*, for Magnetic Oxide Paint.

Wright & Co., *London*, for Fireproof Fixing Blocks.

CLASS II.—SEWERAGE AND WATER SUPPLY.

Cuerden, R., *Bolton*, for Morrison's Spray Lavatory.

Cuerden, R., *Bolton*, for Shanks's "Imperial" Lavatory.

Cuerden, R., *Bolton*, for Shanks's "Reliable" Water-waste Preventer.

Cuerden, R., *Bolton*, for Shanks's "Tubal" Wash-out Closet.

Doulton & Co., *Lambeth*, for Stoneware Safety Pipes, in Long Lengths.

A These were exhibited at York, but the testing was not completed in time for the last report.

B This was exhibited at Leicester, but the testing was not completed in time for the last report.

Doulton & Co., *Lambeth*, for Improved Siphon Flush Tank.
Parkinson, Sweaney & Co., *Manchester*, for Air-tight Soil Pail, with Slide Catch.
Parkinson, Sweaney & Co., *Manchester*, for Laws' Pathway Rubbish Receiver.
Vause, J., & Son, *Bolton*, for Cast-iron Smooth Bore Drain Pipes and Fittings.
Vause, J., & Son, *Bolton*, for Craig's White Enamelled Sinks.
Vause, J., & Son, *Bolton*, for Ruffard's Enamelled Fire-clay Bath.
Vause, J., & Son, *Bolton*, for Shanks's "Imperial" Lavatory.
Vause, J., & Son, *Bolton*, for Shanks's "Reliable" Water-waste Preventer.
Vause, J., & Son, *Bolton*, for Shanks's "Tubal" Wash-out Closet.
Vause, J., & Son, *Bolton*, for Shanks's Urinal with Tilting Flusher.
Vause, J., & Son, *Bolton*, for Shanks's Wash-out Closet and Cistern combined, for Country Use.
White, W. P., & Co., *London*, for Nicholls's Soot and Salt Urinal.

CLASS III.—HEATING, LIGHTING, AND VENTILATING.

Control Air Propeller Company, *Bolton*, for Humidifier and Air Inlet.
Elliott, Edminson & Olney, *Manchester*, for "National" Kitchen Range.
Hancock, F. & C., *Dudley*, for New Cooker and Steamer.
Hargreaves & Bardsley, *Oldham*, for "Eclipse" Gas Governor.
Maritime and General Improvement Company, *London*, for Portable Electric Glow Lamp.
Stott & Co., *Manchester*, for Combined Gas Governor and Cut-off Valve.
Wilson, Charles, & Sons, *Leeds*, for Open Gas Fire.
Wilson, Charles, & Sons, *Leeds*, for Gas Kettle.

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS, AND DISINFECTANTS.

Barlow, W., *Bolton*, for "Souple" Boots.
Calvert, F. C., & Co., *Manchester*, for Soluble 70 per cent. Carbolic Acid.
Cleworth, Isaac, *Bolton*, for Cadbury's Chocolate and Cocoa Essence.
Humphreys & Thomas, *Narberth*, for All-Wool Flannels (Undyed).
Lythgoe, W. R., *Bolton*, for Confectionery with harmless colouring matter.
Morrell's Sanitary Company, *Manchester*, for Cinder Sifting Dust Bin.
Rothwell, W., *Bolton*, for Woollen Fabrics

CLASS V.—MISCELLANEOUS ARTICLES OF SANITARY INTEREST NOT INCLUDED IN THE ABOVE CLASSES.

Maritime and General Improvement Company, *London*, for Loeb's Respirators.

Peck, J. H., & Co., *Wigan*, for Ambulance Stretcher for Use in Mines.

The following, which have gained awards at previous Exhibitions, are now so well known and their merits are so fully appreciated, that the Judges do not think it necessary to make any further award to them:—

Moule's Earth-Closet.
Calvert's Pure Carbolic Acid.
Potts' Edinburgh Sewer Trap.
Buchan's Disconnecting Trap.
Buchan's Access Pipe.
Stott's Mercury Gas Governor.

In conclusion, the Judges would call attention to a resolution of the Committee with reference to the deferred Exhibits. Hitherto it has been the rule to charge Exhibitors a small fee towards the expenses of the necessary arrangements for testing the deferred Exhibits in London. These fees have been only nominal, and in many cases the expenses have been largely in excess of the fees received, sometimes six or eight times as much. The burden on the Exhibitors has, therefore, been very slight. This year, however, the Committee has decided to relieve the Exhibitors from even this nominal charge, and to meet the expenses of testing the deferred Exhibits out of the funds of the Institute.

We regret that we are unable to recommend the award of the Richardson Medal.

(*Signed*) ROGERS FIELD, B.A., M.Inst.C.E., *Chairman.*
A. WYNTER BLYTH, M.R.C.S.
W. H. CORFIELD, M.A., M.D.
W. EASSIE, C.E., F.L.S., F.G.S.
BALDWIN LATHAM, M.Inst.C.E.
HENRY LAW, M.Inst.C.E.
T. HAYTER LEWIS, F.S.A., F.R.I.B.A.
LOUIS PARKES, M.D.
J. WALLACE PEGGS, A.M.Inst.C.E.
ERNEST TURNER, F.R.I.B.A.

ANNUAL REPORT OF THE COUNCIL FOR 1887-8.

THE Eleventh Annual Report, which the Council now submit, has this special feature of interest; that on account of the anticipated amalgamation with the Parkes Museum it will probably be the last report of the Council of the Sanitary Institute as at present constituted.

The Anniversary Meeting was held in the Parkes Museum on July 14th, 1887. The chair was taken by Sir Douglas Galton, K.C.B., F.R.S., who presented the Medals and Certificates which had been awarded to the successful Exhibitors at the Exhibition at York in 1886, and an address was given by Dr. G. V. Poore, on "The Shortcomings of some Modern Sanitary Methods."

The Congress was held in the town of Bolton, under the presidency of the Right Hon. Lord Basing, F.R.S. Unfortunately an important strike which prevailed in the town at the time considerably interfered with the pecuniary success of the meeting. There were present seventy-five Members of the Institute; and one hundred and seventy tickets were taken by Associates of the Congress.

The Sanitary Authorities of Manchester, Salford and other towns, appointed deputations or representatives to attend the Congress.

Many interesting subjects were brought forward in the various Sections, a full report of which, with the papers read and the discussions upon them, will be found in the forthcoming ninth volume of the Transactions.

The Conference of Medical Officers of Health, which was held in connection with the Congress for the first time at York, was repeated and further developed at Bolton, a whole day being devoted to the papers and discussions. These Conferences have been well attended, and have proved to be a very satisfactory addition to the work of the Congress.

The Exhibition was held in the new Drill Hall, to which a special Annexe was added.

Cookery Lectures were given each day in the Exhibition, and also demonstrations of Butter making and other Dairy work.

The Exhibition was open twenty-nine days, and was visited by about twenty-seven thousand persons. There were one hundred and

twelve Exhibitors. The Judges awarded six Medals, eight Special Certificates, and thirty Certificates; the Special Certificates being awarded to exhibits which had received medals at previous Exhibitions of the Institute. Fifty-six Exhibits were deferred for further practical trial and testing. The results of these trials will be reported at the Anniversary Meeting in July, when the Medals and Certificates will be presented.

Two Examinations of persons desirous of qualifying for the appointments respectively of Local Surveyor and Inspector of Nuisances were held in June and November. In June seventy-seven Candidates presented themselves, nine for the former and sixty-eight for the latter Examination. The Examination extended over two days, being partly written and partly oral. Four Candidates were certified to be competent, as regards their Sanitary knowledge, to discharge the duties of Local Surveyor, and forty-four to discharge those of Inspector of Nuisances. In November sixty-two Candidates presented themselves, eight as Local Surveyor and fifty-four as Inspector of Nuisances. Three Candidates were certified to be competent, as regards their Sanitary knowledge, to discharge the duties of Local Surveyor, and thirty-one to discharge those of Inspector of Nuisances. The total number of Candidates—one hundred and thirty-nine—is a larger number than that recorded in any previous year.

Many of the Candidates have derived much benefit from the courses of Lectures arranged by the Parkes Museum, which are always well attended.

Since the Institute was first established twenty-two Examinations have been held, and four hundred and eighty-four Candidates have been examined. Forty-nine have passed the Examination for Local Surveyor, and two hundred and seventy that for Inspector of Nuisances.

During the year the two volumes of "Public Health Reports," by Sir John Simon, K.C.B., were published by the Institute.* Six hundred and twelve persons entered their names as Subscribers to the work, which, however, has not at present paid the cost of publication, the expenses having been unexpectedly heavy and a large number of copies being still on hand.

* NOTE.—The Council wish to acknowledge the fact that the Editor, Dr. Seaton, sacrificed a valuable set of reports in the preparation of this work.

There is a continuous demand for the volume of "Vital Statistics," by Dr. Farr, which was published more than two years ago: and during the year forty copies of the work have been sold. A profit of nearly £90 has at present resulted from this publication, heavy as the expenses have been, and there still remain over two hundred copies on hand.

A Special Committee was appointed by the Council to consider Bills relating to sanitary matters introduced into Parliament, and on their recommendation the Council decided to take the following action with regard to Bills introduced last Session: to petition against the Bill for the better Sanitation of Houses in the Metropolis, and against the Sanitary Registration of Buildings Bill, which were withdrawn or rejected; to petition in favour of the Water Companies' (Regulation of Powers) Bill; and of the Bill to Regulate the importation, manufacture, and sale of Butter Substitutes, which were both passed; and to take no action with regard to the Rivers' Pollution Prevention Act, 1876, Amendment Bill and the Bill for the better Prevention of the Fraudulent Sale of Oleomargarine, which were withdrawn. With regard to the Bills introduced this Session, the Council decided, on the recommendation of the Committee, to petition against the Architects and Engineers Registration Bill, which has been withdrawn, and also against the Sanitary Registration of Buildings Bill.

The Council having been informed, in October last, that the Kensington Vestry had requested the President of the Local Government Board to bring in a Bill to provide for compulsory notification of infectious diseases, addressed a communication to the Board, forwarding copies of the resolution of the Council in support of this request. The Council also wrote to the Metropolitan Asylums Board, and to the several Vestries and District Boards in the Metropolis, requesting that they would be pleased to support the Kensington Vestry's application to the Local Government Board. In response to this communication, several of the Vestries and District Boards reported that they had taken or were about to take action in the matter, as suggested.

The Council sent at the same time copies of a resolution to the Local Government Board, the Metropolitan Asylums Board, and the several Vestries and District Boards of Works, expressive of their

satisfaction in observing the efforts recently made by the Asylums Board to facilitate the admission of infectious cases to their hospitals by removing patients upon the application, not only of Sanitary Officials, but also of duly qualified Medical Practitioners, without the intervention of the Poor Law officials.

Subsequently a Bill entitled Public Health (Prevention of Infectious Diseases, &c.), was brought in by Mr. Hastings and other private members, and was ordered by the House of Commons to be printed on 20th March last. It is drawn in the terms of the Model Clauses of the Select Committee on Sanitary Regulations, and is described as a Bill to amend the Public Health Act, 1875, so as to make further provision for the Prevention of Infectious Diseases, and for other purposes. Essentially it is a Bill to provide for Compulsory Notification of Infectious Diseases, but as drawn will not apply to the Metropolis. The Council have decided to petition Parliament in favour of the principle of the measure.

A deputation was appointed by the Council to attend the International Sanitary Congress at Vienna, and in conjunction with the Parkes Museum and the Society of Medical Officers of Health an invitation was given to the Congress to hold its next meeting in London. The invitation was accepted, but the meeting will not take place until 1891, on account of a somewhat similar Congress and Exhibition proposed to be held in Paris in 1889.

The Council have had under consideration the question of the Federation of the various Sanitary Societies of the United Kingdom, which was suggested by the Manchester and Salford Sanitary Association. In view however of the anticipated amalgamation with the Parkes Museum, the Council consider that it is not desirable to take any action in the matter at present.

A loyal address of congratulation was forwarded to Her Majesty on the occasion of her Jubilee, and was graciously acknowledged.

It is with much regret that the Council have to report the deaths of Dr. Lory Marsh, who rendered valuable assistance in the formation of the Institute and acted as its Registrar for several years, and of Prof. de Chaumont, who had been a highly-valued member of the Council since the foundation of the Institute, and for a period acted as its Chairman. The Council feel that the death of so able a teacher of Sanitary Science is a serious loss, not only to the Institute, which

will greatly miss his services as an Examiner and a Judge of the Exhibitions, but also to the whole of the sanitary world, in which he was so well known and respected. The Council also record with regret the deaths of Prof. Gaetano Pini (Hon. Foreign Associate), of A. Denison (Fellow), and of Sir R. N. C. Hamilton, K.C.B., Sir William McArthur, K.C.M.G., and A. Harland (Members).

During the year 1887 there were elected: one Fellow, twenty-six Members, and twenty-two Associates, being the largest number elected in any year since 1880. The roll of the Institute comprised, at the close of 1887: ninety Fellows, one hundred and ninety-nine Members, eighty-one Associates, nine Subscribers, and twenty-eight Honorary Foreign Associates; making a total of four hundred and seven.

The retiring Members of Council are: Charles E. Cassal, F.C.S., F.I.C., Prof. F. De Chaumont, M.D., F.R.S. (deceased), T. Orme Dudfield, M.D., W. Eassie, C.E., F.G.S. (resigned), W. Horton Ellis, F.R.MET.SOC., and Edward Pritchard, M.INST.C.E.

The following gentlemen have been nominated by the Council for election at the Annual Meeting to fill the vacancies thus created: R. W. Peregrine Birch, M.INST.C.E., Henry C. Burdett, F.S.S., R. Brudenell Carter, F.R.C.S., Director-General Sir Thos. Crawford, K.C.B., M.D., James Mansergh, M.INST.C.E., and the Hon. F. A. R. Russell.

The Right Hon. Lord Braye, who has held the office of Treasurer of the Institute since 1879, has expressed a wish to resign, as he lives so far from London that he is unable to take any active part in the work of the Institute. The Council have nominated Inspector-General R. Lawson for election as Treasurer.

During the year Lectures and special Demonstrations were given in the Parkes Museum. Members of the Institute had the privilege of attending them and of using the Library.

With reference to the proposed amalgamation of the Institute with the Parkes Museum, the Council regret that the application to the Privy Council for the grant of a Charter was not acceded to; but arrangements are now nearly completed for incorporating the combined societies under the regulations of the Board of Trade.

By Order,

74A, Margaret Street, E. WHITE WALLIS,

16*th May*, 1888. *Secretary.*

SANITARY INSTITUTE OF GREAT BRITAIN.

Abstract of Cash Receipts and Payments for the Year ending December 31st, 1887.

	£ s. d.	£ s. d.
To Balance at Bank, January 1st		201 16 2
„ Fellowship Fees	10 10 0	
„ Admission Fees	58 16 0	
„ Life Compositions	133 7 0	
		202 13 0
„ Annual Subscriptions		233 10 3
„ Transactions and other Publications ...	104 18 0	
„ Congress—Sale of Tickets	67 14 6	
„ Examination Fees	285 12 0	
		458 4 6
„ Dr. Farr's Works...		66 8 4
„ Mr. Simons' Works		652 18 0
„ Transfer from Exhibition Account ...		100 0 0
		£1915 10 3

	£ s. d.	£ s. d.
By Rent and Taxes	40 12 6	
„ Salaries and Wages	295 19 7	
„ Postage, Telegrams and Carriage ...	41 6 1	
„ Incidental Expenses	33 3 11	
„ Stationery and Printing	80 8 9	
„ Medals and Certificates	15 1 5	
„ Library	2 5 6	
		508 17 9
„ Transactions	233 18 3	
„ Congress	161 6 11	
„ Examinations	241 19 8	
		637 4 10
„ Dr. Farr's Works...		26 5 0
„ Mr. Simons' Works		293 3 0
„ Amalgamation		28 12 6
„ Balance at Bank, December 31st ...		421 7 2
		£1915 10 3

EXHIBITION ACCOUNT.

	£ s. d.
To Balance January 1st...	95 1 7
„ Receipts	500 6 3
	£595 7 10

	£ s. d.
By Expenditure	483 4 7
„ Transfer to General Account	100 0 0
„ Balance December 31st	12 3 3
	£595 7 10

Audited and Confirmed.

23rd April, 1888.

MAGNUS OHREN, } *Auditors.*
EDWARD C. ROBINS, }

ADDRESS

By Professor W. H. Corfield, M.A., M.D., Oxon.

CHAIRMAN OF COUNCIL.

Read at the Annual Meeting, May 16th, 1888.

As the Institute is now about to be incorporated with the Parkes Museum and to begin a new phase of its existence, I think that it may not be inopportune if I place before you a short *résumé* of the work it has achieved. The Sanitary Institute was founded in the year 1876, because, as stated in the Report published in the Journal of the Leamington Exhibition, "The increasing importance attached to Sanitary Science, and the recognised position it is assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health."

The Meeting for the foundation of the Institute was held at St. James's Hall on the 13th July, 1876, under the Presidency of His Grace the Duke of Northumberland, who has thus been the President of the Institute from its very commencement. At this meeting the two following resolutions were passed :—

1. "That in the opinion of this meeting the Sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health,' a Society be now formed to be styled 'The Sanitary Institute of Great Britain.'"

2. "That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution, and of reporting to an adjourned public meeting to be held in the second week of October next."

The Committee appointed under the second resolution prepared an important report on the proposed functions of the new Institute, dividing their report into five Sections.

Section I. provided for "The examination of, and granting certificates of competence to, Local Surveyors and Inspectors of Nuisances." Under this heading the Committee advised that at first the examinations should be held in London only, but suggested "the desirability of instituting local examinations as soon as suitable arrangements could be made."

Section II. comprised "Matters relating to Medicine in connection with Public Health." Under this heading the Committee suggested that the Institute should "take such steps as may be within its power, through its branches or otherwise, to obtain a complete registration of sickness, especially of zymotic disease"; they also advised that the Institute "should endeavour to secure the services of Medical men especially qualified to give lectures on subjects relating to the prevention and spread of disease"; also that relations should be established with Medical Officers of Health with the view of assisting them in the discharge of their duties.

Section III. referred to "Matters relating to Chemistry in connection with Public Health," and provided that the Institute should be prepared to investigate the chemical aspects of processes for the treatment of sewage or of nuisances from factories, &c., and to furnish reports on such processes for fees to be fixed by the Council. This section moreover provided that "The Institute should not undertake any analysis or other work which may interfere with the private practice of Chemists, Engineers, or other professional men, but should confine itself to giving information and advice on questions of public interest submitted to the Council and approved of by them."

Section IV. treated of "The form of Constitution most desirable for the Institute." The Committee considered that it was not desirable at the time to apply for a Charter of Incorporation, as the work of the Institute could go on for a time very well without it, as the examinations, if successful, would add considerable weight to the application for a Charter at some future time, and as the Committee considered "that as the Institute progresses the points which the Charter should embrace will be better understood than at present." The Institute was to consist of Annual Members paying one guinea and Life Members paying ten guineas, and to be governed by a President, Vice-Presidents, and a Council of twenty-four Members, one-third of whom were to retire annually but to be eligible for re-election. Country and District Associations and Societies of Medical Officers of Health were to be invited to

affiliate themselves to the Institute. A Library of reference was to be formed, and donations of books, &c., were invited.

Section V. provided for "The establishment in London of an Exhibition of Sanitary Apparatus and Appliances." This Exhibition was to be of a permanent character, the contents to be carefully arranged, classified, and labelled. It was proposed to charge rent to the Exhibitors for the space occupied, and a catalogue was to be published as soon as possible. This report was unanimously adopted at a public meeting held on the 14th March, 1877, and the first Council, with Dr. B. W. Richardson as Chairman, was subsequently appointed to carry it into effect.

It will be noticed that the holding of Congresses was not mentioned in the report as one of the objects of the Institute; nevertheless, one of the first things done by the new Institute was to hold a Congress in Leamington in 1877 under the presidency of the Chairman of Council; this Congress was a success, and a number of valuable communications were brought before it. Unfortunately no official arrangement was made by the Institute to publish the transactions of the Congress, of which the only record is the Journal of the Leamington Congress and Exhibition, edited by Dr. Lory Marsh, the Registrar of the Institute, a volume which it is now almost impossible to procure.

A Congress has been held every year since, with the exception of 1881, in which, on account of the Medical and Sanitary Exhibition in connection with the International Medical Congress in London, it was not considered desirable to hold a Congress of the Institute. An Exhibition of Sanitary Appliances has been held in connection with each Congress, and the greatest possible pains have been taken by the Judges to ascertain by practical testing the value of the exhibits, so as to make the awards of Medals and Certificates a trustworthy guide to the public. A list of these Congresses will be found on pages 31 and 32 of the last volume of the Transactions (Vol. VIII). There can be no doubt that these Congresses, and the Exhibitions connected with them, have been an important means of stimulating, and of interesting the public in, sanitary work throughout the Kingdom.

The Examinations for Surveyors and Inspectors of Nuisances recommended by the original Committee, were commenced in October, 1877, at which Examination there were eight candidates, five of whom obtained Certificates. At the second examination in February, 1878, there were seven candidates, five of whom obtained Certificates. Three Examinations were held in 1878, and two in each subsequent year. The numbers of the candidates applying continued small until 1884, when

they suddenly jumped to fifty, having been only twenty in 1883. From that time they have rapidly increased, until in 1887, as stated in the report which has just been read, no less than one hundred and thirty-nine candidates presented themselves, of whom eighty-two satisfied the examiners. These Examinations have supplied an important want, and the Certificates of the Institute are becoming highly valued by candidates for the posts of Local Surveyor and of Inspector of Nuisances.

It has not been found practicable to carry out the idea of holding the Examinations elsewhere than in London, chiefly on account of the impossibility of getting a sufficient number of the examiners to attend elsewhere.

At the Extraordinary General Meeting of the Institute held on December 12th, 1878, the "Basis of the Constitution of the Institute," and the "Objects of the Institute" were defined (see Transactions, Vol. VIII., pp. 13 to 16). By the Basis of Constitution, the Institute was defined as consisting of Fellows, Members, Associates, and Subscribers; the Method of Election, and all Fees payable, and a variety of other details were settled. It was provided that "Medical Officers of Health and medical men holding certificates in Sanitary Science from any University or Medical Corporation, shall be entitled to be nominated as Members of the Institute without admission fee," and that "all persons who have passed the Examination and received a Certificate for Local Surveyor from the Institute, shall by virtue of having so passed, become Members of the Institute upon the payment of five guineas (without annual subscription) in addition to the fee paid for the Examination;" and that "all persons who have passed the Examination, and received the Certificate for Inspector of Nuisances from the Institute, shall by virtue of having so passed, become Associates of the Institute upon the payment of three guineas (without annual subscription) in addition to the fee paid for the Examination." It was provided also that "the Institute shall be governed by a President, Vice-Presidents, and a Council of twenty-four, consisting of Fellows and Members of the Institute, of whom, not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year": thus ensuring the admission of "new blood" to the Council. Power to elect Honorary Members, Honorary Foreign Associates, and Corresponding Members, was given to the Council. The objects of the Institute were to be the "advancement of Sanitary Science, and the diffusion of knowledge relating thereto"; the Examining, and granting Certificates of competency in Sanitary knowledge to Local

Surveyors and Inspectors of Nuisances; the holding of Congresses, and Exhibitions of Sanitary apparatus and appliances; the taking of steps "to obtain a complete registration of sickness, especially of preventible disease;" and "the formation of Classes for Technical Instruction in Sanitary Science, and the formation of a Library." Subsequently the present Bye-Laws were prepared, and unanimously approved and adopted at the Annual Meeting on May 29th, 1879.

Ordinary meetings in London were organised by the Council in 1881, and at these several important papers were read and interesting discussions resulted, but for various reasons these meetings have for some time past been abandoned; at no distant date, however, it will probably be found advantageous to hold such meetings again.

At the ordinary meeting on July 24th, 1883, the subject of "The Compulsory Notification of Infectious Disease" was discussed, the Council having thought it desirable to ascertain the facts on this subject and having requested me to prepare a paper on it. A series of questions was sent to the Medical Officers of Health of each of the towns in which compulsory notification was in force, and the result was that the evidence was very strongly in favour of such compulsory notification. The Council has recently, as mentioned in the report, decided to petition in favour of the principle of the bill now before Parliament for this purpose. In connection with this subject I may mention that, in January, 1882, at the request of the Royal Commission appointed to enquire into the Small-Pox and Fever Hospital Accommodation, the Council drew up a number of recommendations, including "Suggestions as to the size and arrangements of the wards, the general construction, size and isolation of Small-Pox and Fever Hospitals, arrangements for ambulance conveyance of Patients, and the establishment of Convalescent Buildings." These recommendations were laid before the Royal Commission by the Chairman of Council (the late Professor de Chaumont), who explained at length the views of the Council on the matter.

I must not omit to mention the munificent prize of £200 given by the Rev. Wyatt Edgell, for an essay on "The Range of Hereditary Tendencies in Health and Disease"; this valuable prize was awarded by the adjudicators, the late Dr. W. Farr and Dr. B. W. Richardson, to Mr. George Gaskoin, M.R.C.S.; nor the special medal offered by Dr. B. W. Richardson each year for an exhibit selected out of the entire Exhibition, and to be awarded in case of pre-eminent merit only. This medal has been awarded on several occasions.

At each of the Anniversary Meetings addresses on important

matters connected with the Public Health have been given, and will be found in the Transactions.

By the approaching amalgamation of the Parkes Museum with the Sanitary Institute, the latter will be provided with a permanent museum of sanitary apparatus and appliances, as contemplated by the founders of the Institute; and the combined Libraries will form the finest Library of sanitary works in the kingdom.

I feel that this short summary gives but a faint idea of the amount of work performed by the Institute during its short period of existence; but those who wish for a more intimate acquaintance with the matter, can obtain it by studying the volumes of Transactions which have been published during the last nine years.

THE STORAGE OF LIFE AS A SANITARY STUDY.

Address by Benjamin Ward Richardson,
M.A., M.D., LL.D., F.R.S.

Anniversary Meeting, July 12th, 1888.

Mr. President, Ladies, and Gentlemen,

In one of the most charming books of natural science, "The Select Works of Antony van Leeuwenhoek," the Immortal Beadle of the little town of Delft, and the first and, in some respects, the greatest of all the microscopists, there is an essay in which the philosophic writer enters into a speculation on the duration of life of different classes of animals. With that singular foresight which marks the work of this original investigator, he indicates that certain animals which present the shortest term of life produce the greatest number of young. He adduces the shrimp as a case in point. The shrimp propagates by eggs, and in such numbers that once, he says, when he began to count the eggs in one shrimp, he had not got through the mass of them before he was tired and gave up the attempt. He then proceeds to compare these small and prolific animals with mighty monsters like the whale, and points out that such monsters bring forth their young perfectly formed and only a single one at one time; for, if these larger animals were as prolific as the smaller, the smaller would all be devoured by them, the sources of food would be stopped, and the feeder and the fed would soon become extinct.

From the contemplation thus started Leeuwenhoek proceeds to speculate on the length of life of the largest creatures, like the whale. Reflecting on the enormous bulk of these creatures, and on those huge bones of theirs which are in many places fixed up for public view, he conjectures that some of them might be of the age of a thousand years and upwards. For he says, "I am persuaded that fishes never die of old age, forasmuch as their bones, being always of a soft texture which never grows hard, may always be extended, so that the fish themselves are always growing larger. But terrestrial animals are exposed

to the changes of atmosphere, whereby their bones grow hard, and when the bones are hardened, the body cannot be extended to a large size."

If this argument of the illustrious first microscopist were true, we sanitarians who have for our special business the art of prolonging life—human life especially—ought to set to work at once to find out a plan by which the bones of human beings could be kept in such a state of softness that they could continue to expand and extend, so that giants should be re-established like the race of giants of antiquity. And pray observe that the idea is not really absurd because it is at this time impossible. *Cœteris paribus*, it is probable that symmetrical and healthy size does largely determine the question of age, and that in the history of the natural life of man there may have been conditions in which human beings of immense build and prodigious strength did inhabit the earth, and did live to an extraordinary age, according to our present idea of human longevity, because they were giants. To this observation let it also be added that in the life-history of other animals there are, apart from size, other examples of remarkable length of life. There are instances of fish—the pike as the best known instance —in which life has been maintained for a period of over 200 years. There is, I believe, at the present time in the island of Mauritius a tortoise, a photograph of which I have here, which has lived between 100 and 200 years. An elephant has been known to live 150 years, and I myself have seen a parrot which, on evidence that was unmistakeable, had turned its 100th year.

There seem, indeed, to be amongst certain animals natural periods of life, which, by comparison with the common period of the life of man, are extremely prolonged. The animals, by some peculiar process, as yet but little investigated, hold life as a long possession, and to this faculty I apply the term, "The Storage of Life," applying it to-day to human life, because up to current date the sanitary question is confined mainly to the interests of members of the human family, and because the storage of life by the aid of sanitation in that family opens up for us, as sanitarians, a new idea of investigation and labour.

Some sanitarians think that a general death-rate is an indication of the storage of life in a community. They who think so are right and wrong. They are right when their view is applied to the storage of life throughout all the members of a community. They are wrong when it is applied to the individual members of it; and it is to this part of the question that our study of the moment belongs.

In a community where the average rate of death is extremely high there may be found individuals of great longevity. In a

community where the death-rate is, and has been for a long time, exceedingly low there may be found individuals of remarkable age, and this is how the matter stands in regard to death-rate and storage of life.

I content myself to-day with the consideration of the storage of life in the individual, as apart from the community, because the individual question is the greater one, and, in fact, includes the whole question; for if the means could be successfully applied of extending the life of the unit on a systematic plan, the discovery would have been made of the method of extending the life of the masses altogether, if the masses wished for the extension.

Looking at the subject before us from the facts that lie at our command, there is good evidence in hand to show the individual storage of life may be far greater than the vast majority of people either expect or hope for. The mean duration of life in this country may be taken at forty-one years. But we have instances upon instances in which this storage of life is doubled, and some in which it is trebled. Quite recently I had, at the same time, in the consulting room three gentlemen whose united ages reached the total of 262 years, or over 87 years each, and each with a fair promise of from four to five years more of life at least. I also, within the present quarter, saw on the same day two gentlemen whose united ages gave 186 years, or an average of 93 years each. I have seen, and carefully examined physically, a woman who had attained the age of 105 years, and who lived afterwards for three or four years; and, at the request of the individual himself, I once made an examination, after death, of the body of a man who had passed his ninety-third year.

In all these examples, and in many others which in the course of a long professional career have come under my observation, there was nothing in the social condition of the individuals concerned that could of itself account for such an unusual storage of life as that which they presented. Two of those specially referred to were men of the highest class of mental power; the other has come down from one of the oldest of the noble families of Europe, and in the course of a most chequered and active career has been exposed to singular pressures, mental and bodily; a fourth has fought his own way from the lowest position to one of affluence and power; whilst the oldest of all was, from first to last, in abject poverty, and at the time when I visited her was in a workhouse, in which she had lived for several years, and in which she remained until her death.

When we have before us a series of *bonâ fide* facts like these, which we can multiply to almost any extent by looking for them,

and which are, indeed, so common that the narrative of a few of them soon becomes commonplace, we feel that the sanitary problem, how to increase the power of storage of life in the individual, must after all be a very simple one indeed. I am bold to say that it is very simple, the simplest of the simple, when the elements of it are understood and the conditions leading to it are properly appreciated.

To break ground on this question, and to show that the question belongs to us as sanitarians, is the object of the present discourse. It is a sort of study, which at the present moment we especially want to cultivate. To the great public the details we are apt to put forward about drainage, ventilation, baths, disposal of sewage, house construction, and the like, are becoming, by constant repetition, utterly wearisome; here we have a subject which is new for study, which opens up some of the most important researches affecting the history of mankind, past and present, and which will be practically useful for the future.

The Problem Stated.

The problem that lies before us may be briefly stated as follows. Certain proofs of the power of the human body to lay or store up life to a prolonged period are admitted. What are the conditions which favour such storage, and how can we promote such conditions?

The conditions are the following, and in the order stated:—

1. Hereditary qualification.
2. The virtue of continency.
3. Maintenance of balance of bodily function.
4. Perfect temperance.
5. Purity from implanted or acquired disease.

Hereditary Qualification.

I put the question of hereditary qualification in the first place because I feel sure, from observation and collection of data, that this is its true position. The fact is one of the most singular in the whole inquiry, and perhaps the most instructive. When the hereditary faculty for the storage of life is implanted in an individual body for a few generations it becomes, so to speak, an established principle, and the representatives of it, having once arrived past the period of life in which accidental deaths of various kinds are causes of mortality, continue to live, often in opposition to the most adverse influences to the

continuance of life, beyond the average term of life. The person gifted with this faculty of storage may be of fragile and delicate build of body, may even be deformed of body, may be of dull or of bright intellect, may be of cleanly or of uncleanly habit, may be placed in what would seem the most unfavourable position in life, or may be literally in want, and will yet continue to live on so as to see the whole of his or her more fortunate neighbours fall; nay, may even be so tired of the continuance of the monotony of the everlasting recurring phenomena of life, as to be envious of the fate of the dead who have found their rest. Such a person may also be what is commonly called an "ailing body," not from the existence of any well-marked organic disease, for that is incompatible with the condition requisite for vital storage, but from a general feebleness and want of tone which affects alike unfavourably the mental as well as the physical powers. It is not necessary to convey by this statement that feebleness of the kind here described is a part of the required condition for storage, since they who are of the very opposite condition, the very strong, may possess the selfsame faculty; but the existence of the faculty in the weak as well as in the strong must be affirmed. It is right also at this point to state that the storage of life in those who possess it in the most marked degree is and belongs to continuance of the process of life, not to the power of resisting interruptions to it in and during periods of strength and youthfulness. I can find no shadow of proof that those who have attained the oldest life have done so by virtue of any special physical ability inherent in them to resist the most fatal diseases. They have pulled through diseases, but they have not evaded them, and there is no evident proof that their special quality for a long life has materially aided them in the pulling through. The evidence is rather in favour of the view that, after having passed through the ordinary battles of disease, they have continued to hold on and enjoy the inborn capacity to live longer than their contemporaries in the race of life.

We have seen that peculiarities of body which do not seem to be favourable to the storage of life are, notwithstanding, compatible with it. Are there, on the other hand, any conditions or peculiarities of body which are signs of its existence in the individual?

Whatever peculiarities of this kind exist are strictly of the hereditary character, and are conveyed to the observer in the story of temperaments, rather than in any striking characteristics of strength or beauty. Thus, with whatever general appearances of body they may be combined, there are two temperaments which are incompatible with life-storage, and

two which are so compatible with it that either in their single or their combined form they are, as I think, essential to its manifestation.

The two hereditary temperaments which, either singly or in combination, are incompatible with storage of life are the nervous and the lymphatic; the two which are compatible, and perhaps necessary, are the sanguine and the bilious. If we divide life into seven periods: (1) from birth to fifteen years—completed childhood; (2) from fifteen years to thirty—completed adolescense; (3) from thirty years to forty-five—completed manhood or womanhood; (4) from forty-five to sixty—ripened manhood or womanhood; (5) from sixty to seventy-five—first period of decline; (6) from seventy-five to ninety—second period of decline; (7) from ninety to one hundred or upwards—period of senile maturity,—if we divide life into these seven parts, according to age, we may fairly apportion the life-value of the temperaments as follows, supposing the representatives of each temperament to run their natural course.

The storage of life in the sanguine temperament would be extended to the sixth stage, with an inclination to the seventh.

The storage in the nervous temperament would be to the fifth stage, running into the sixth.

The storage in the bilious temperament would be to the sixth stage at most.

The storage in the lymphatic temperament would be to the fifth stage.

Better, perhaps, than any of the single temperaments would be a mixture of the sanguine and the bilious, and, indeed, all the examples of special life-storage which I have met with have been of this hereditary admixture.

The organism which is best constituted for storage is therefore capable of being identified, and stands out, so to speak, in its own colours. The colour of the iris or curtain of the eyeball, always an excellent test, is a light hazel; the hair is dark brown; the colour of the skin is inclined to be florid, and the lips and eyelids are of good natural red—never pale, as in the pure nervous temperament, and never of dark bluish tint, as in the lymphatic or lymphatic bilious. In this mixed temperament of the sanguine and bilious a preponderance of the sanguine is, I believe, always an advantage.

The qualities here enumerated as represented in an organism well fitted for the storage of life are absolutely of hereditary character. They spring from combinations of parentage, and when the combinations are unalloyed by the introduction of any disturbing elements of disease, the conditions for long storage are fortunately combined.

But what is the precise difference physically of a human body so constituted by heredity, as distinct from a body less favoured, and that can give the capacity of storing up life, it is impossible to say. To declare that it is something derived from birth is to declare nothing more than a fact which, if we try to trace it back in its ancestral sense, is lost in the inquiry; that is to say, though it may be traced back for generations, it is lost at last historically, in regard to the cause of its origin.

As tending to throw an indirect light on this vital puzzle there are, however, a few facts which are worthy of regard. I have noticed that when the tendency to long storage of life is present, by heredity, it need not be so from both parents. The tendency may descend strongly in one line, although it is always most pronounced, and is most certain, when it descends through both. When, again, it descends on one side only, it is strongest on the male side.

If a good number of facts are collected in which the ages of parents, paternal and maternal, are discovered, the readings of the storage of life are so regular that a sufficient number would, I believe, yield an absolute record. I once had the opportunity of reading a series of histories of families whose paternal and maternal life-pedigrees were traceable with reliable accuracy. They were derived from insurance records, and if not always so complete as was wished, were good of their kind, and gave results that were more than approximate in their quality, and may indeed be accepted as indicative of the natural truth. From these readings it was elicited that whenever the life-pedigree can be traced through the parental lines for two complete generations, the value of the life of the third generation—accidents being of course excluded—is predicated with a certainty that is rather alarming to timorous minds. There need be no risk, commercially at any rate, in accepting the conclusion which the facts declare. If, for example, the age at death of the father and mother can be obtained accurately: if the age at death of the paternal grandfather and grandmother can be obtained: and if, finally, the age at death of the maternal grandmother and grandfather can be obtained, there will be at hand for calculation the life-storage of six persons. Presuming, then, that the said six persons all reached their full age, the simple sum of dividing the mean result by six will give the average length of each of the lines of descent, and that result, whatever it may be, will, with certain exceptions to be named later on, be the commercial value of the age of the third generation to which it refers. Thus, if the sum total of the ages of father and mother, father's father and mother, and mother's father and mother be, say, 360 years, the natural life-

storage of a person descended from them may safely be taken as sixty years.

The exceptions seem to run as follows: Sixty years is a turning point or point of equality, at which point the indications of the final stage of storage are all but absolutely represented. In other words, sixty means sixty all round. But if the combined term of years equalises out at something under sixty—say fifty, then the term belonging to the surviving representative would not be fifty, but something under it—say forty-eight. If the term should be still lower—forty, for example—the reduction of the last living representatives would be proportionately reduced. On the other side, if the mean value of life of the six standards exceeded the equal point of sixty, then the value of life-storage would be improved. I should estimate that a mean of eighty years, based on the standard of six antecedent lives, would yield a product that might be taken at ninety years at least; a mean of ninety, a product of a hundred years, and a mean of a hundred a product of a hundred and twenty, or even a hundred and thirty years.

In the *St. James's Gazette* of June 25th last a record is given of a man and his wife whose ages at death were respectively eighty-seven and sixty-six, a mean of seventy-six years. They had ten children, four sons and six daughters, dying at these ages: 78, 80, 80, 82, 84, 92, 92, 95, 96, and 96, making an average of over 88 years. The details are important, as are some others in the same essay, but they are defective in that they merely supply the average of one preceding generation as indicative of the life-value of the latest generation.

It may reasonably be asked why and where there should be any change on either side. With a steadily decreasing storage of life why should not families die out altogether, and with an increasing value of life why should families not go on living continuously after the course of a few generations? To the first of these questions the answer is that failing families do die out. To the second it must be admitted that there has been no sufficient time in the history of mankind during historical dates to allow of an answer being given to the inquiry. For my part, I do not see, theoretically, any reason why, in a perfectly constituted human organism, there should be any necessity for the cessation of the storage of life. I see a very obvious necessity for death in a world which is always eating up its vital energy by the prodigal method of over-multiplying the organic forms which need the vital energy for their own existence, because the organic forms must destroy one another in order that the living may continue to live, and this no doubt is the cause, wholesale, of death. But take this cause away, and in place

of excessive reproduction of new forms put reconstruction of existing forms, and there does not appear to be the least reason why the individual storage of life should cease. I should accept that the view of the illustrious Van Leeuwenhoek is theoretically correct, and that some animals, like fish, do not die from old age. They die from accident, from disease, and from being devoured by their fellow-residents of river and sea, but not from old age; that is to say, not from loss of ability to store up life in their bodies.

If this should be true of one species, it should be equally true of another, and should include man in its reading. In other words, it should indicate that there is no such thing, necessarily, as death, but that if life, which has very properly been defined as a forced state, is so, death also is so, and is the bare and pure result of accident, violence, disease, or ignorance of the means for sustaining the natural function of vital reconstruction.

Taking into account all the evidences we possess up to the present time as to the cause or reason why certain members of the human family should possess an unusual faculty for the storage of life, there is but one sign which assists us in the way of explanation—namely, the efficacy of congenital qualification or predisposition obtained from ancestry; in other words, the existence of a faculty that is born, not acquired, and which resembles other personal attributes derived by gradnal evolution.

When I say that the faculty is born in order to be transmitted, I mean that this must be so according to our present position in regard to it, a point of very considerable and, in fact, of vital moment from a practical outlook. For were it to be admitted on unassailable grounds that hereditary descent of faculty is absolute, and absolutely necessary, then all efforts to make general what is now exceptional would be so much time lost in ignorance of principles. The argument, however, would not be just, because there must have been some period in the lives of families when the gift of long life became a family characteristic. We need not suppose that the gift commenced all at once, for that would not be probable. We must rather suppose that it was the work of a gradual evolution, and it is quite just to suppose that it is going on even now in some favoured families, or in some localities, or even in some countries. I have not had time to look the matter up so as to show from strict details that the storage of life is improving in our modern England, but I have not the shadow of a doubt that it is, and that the number of persons who reach the classical three score years and ten at this moment is much above what it has ever been in the history of our country. This tendency is one

of those processes which grows by what it feeds on, and we may justly expect that it will be continued in the future if it be cared for and cultivated, notwithstanding the fact which Mr. Chadwick pointed out in his report of 1842, that centenarians in some places, like Geneva, were rarer at that time than at other previous times when the value of life generally was less favourable.

If it be the fact that the possession of length of days depends primarily on heredity, we, as sanitarians interested in this question, and accepting the study of it as part of our daily work, have to inquire how far we may assist in improving that heredity towards longevity. We need not be deterred in this course by a feeling, sometimes expressed, that if we should succeed in producing a long-lived race, we should thereby secure also an overflowing race, which would over-populate the world. It is not strong and long-lived people who produce a large and helpless community, but, as we shall see in the sequel, feeble and short-lived populations. I mean by this that, in accordance with our own declared reasons for existing at all as a sanitary organisation, we are quite safe in every endeavour we make to extend the duration of individual healthy life, because, in proportion to the extent of our success in this direction, we remove disease, which is an accident, and introduce the fruits of sanitation, which are all in all to us in our special vocation.

We should, in fact, alter the living types of humanity entirely, since our labours would, of necessity, lead to a reduction of large and feeble populations for smaller, stronger, and healthier ones, the sanitary consummation most devoutly to be wished.

Towards the accomplishment of this object the first consideration is the selection of lives for parentage. Unless parentage be sound, it is clear, from what has already been said, that long storage of life in offspring will certainly fail. If such a social miracle could be performed as the fashion of a proper arrangement, before marriage, to prevent, generally, the marriage of health with disease, or, still more urgently, the intermarriage of disease, there would soon be an advance in the value of life on a scale grand in proportion to the extent to which it was carried out.

It would seem at first sight as if there were here a hopeless problem to solve, a hopeless position to attack. It was so not long ago; but I have noticed of late years, and much sooner than might have been expected, a desire on the part of marriageable persons to avoid the many dangers to health which are so likely to spring from unhealthy unions and from unions likely to lead to shortness of life. One essay, for example, in

my own book, "Diseases of Modern Life," on the Intermarriage of Disease, has brought, I find, to me alone no fewer than thirty-two inquiries on various points touched on in that very short chapter, and has led, notably, twice to the sensible and friendly dissolution of engagements which carried out would almost of necessity have favoured consequences of the most disastrous kind. We may therefore reasonably hope to effect, even within the narrow limits of one generation, a basic advancement in this direction if we give our minds to the simple subject of the selection of the fittest of the human species for the continuous representation of humanity.

In the study of the sanitary branch of human knowledge thus referred to we should not be opening any new path, but rather be helping to widen an old one, and making it all the more popular, by the addition to it of physical as well as moral foundations. For ages past the Church has been doing good sanitary work in the care which it has taken to prevent marriages of consanguinity. It seems to have been seen from very early times that intermarriages of persons of the same family led to concentration of the vital failures of the family and to serious disasters from that cause. The wise provision was therefore instituted by the Church of breaking up the family to a considerable but not to a sufficient extent. What miseries a rule of the kind named checks is indicated by the most common evidence, if such evidence be only looked for. It is enough for me to give one proof alone to set it forth in all its solemnity of purpose. I have on my note-books an instance in one family, including in it three generations, in which seventeen persons were all deleted, to use a very significant expression, by the one factor, the intermarriage of first cousins in whom two diseases—consumption of the lungs on one side and cancer on the other—had found an introduction and a diathesis. From one or other of the diseases named, or from curious admixtures of the diseases which need not be described at the present moment, every one of the family group died prematurely. I admit that had they been all gifted with full capacity for life-storage they might have been models of longevity although they were related to each other; but, inasmuch as there would be no reasonable chance of any such concentration of vitality in so many members of one family at the present stage of human progress, the separation of families, for the widest selection of the fittest to live, is the soundest and most practical method.

The question is a sanitary one in the strictest sense of the word, and no argument of a sentimental kind, indicating acknowledged difficulties, ought for a moment to stand in our way. When we desire to raise into active existence horses for

the race or the plough, sheep for the prize show, or even some specimens of flowers or plants for the sake of economy or beauty, we do not hesitate in determining to take the only natural means that are open to us to gain the required result. It is not until we come to the most precious specimen of all life, *man*, that we pause and practically cease to take any pains whatever. We are then so led away by sentiment that we permit the dearest interests to have the go-by, in order not to wound tender sensibilities; or if we do interfere, it is for the sake of some much lower and baser motive than health and good vital storage. I call this bad sanitation.

The Virtue of Continency.

The capacity for storage of life lies first in the force of heredity; but there are, as aids even to that force, and as aids also to a force of life that may not be exceedingly strong, certain other influences which we sanitarians should be the last to ignore or forget. These may be considered as secondary influences in some degree; and yet, at the same time, they may be reckoned as possessing powers that in other points of view are of primary importance. I mean by this that they may become bases of health on which heredity itself may be fostered until it becomes a solid foundation. I have named these influences in the opening passages of this address, and I proceed to study the first of them under the head of the virtue of continency, or that virtue which would provide for the limitation of the family circle to such a degree that the actual necessities of the family may never be dangerously taxed by the largeness of it. I maintain that this is strictly a sanitary question, and that no consideration lying before us as sanitarians is more important. In these days, when the shoe pinches so keenly on the sensitive point of over-population, we are being visited by outbreaks of the extremist views on plans and devices for preventing the exuberance of human life; not everywhere, not all over the face of the earth, but in those centres of the earth where, by causes which may also be called accidental, the numbers of population have exceeded the means at command to keep them in a condition which is, in itself, so artificial as to rank among the abnormal conditions of humanity. The proposals on this matter which some would force on us are themselves abnormal, and, under natural states, would inflict a greater evil than they are intended to prevent, that, namely, of depopulating the earth altogether without controlling the passion which is the root of all evil. This is evidenced at the present time in France, where the systematic decrease of the

people is producing, without any corresponding increase of morals, as serious an anxiety amongst some of the most thoughtful minded there as the excessive growth of population is creating anxiety amongst the thoughtful minded here. It is our duty to avoid these extreme views and, free from panic induced by temporary social and political influences, which are purely human and are sure to be rectified under a better and more enlarged human understanding, try to bring man back to a complete accord with Nature, without infringing even one of her most important laws. Our duty in this respect lies in inculcating the very simplest of all the virtues—CONTINENCY OF LIFE, and in favouring all the conditions which render that virtue possible. We know, fortunately, what those conditions are. We know that under a social state in which health of life and wealth of life would coexist we should have a state where a noble civilization would be combined with a very frugal mode of existence, with moderations of passions and pleasures, and with such restraint of character that violent extremes of any kind would never be exhibited by those who wished to be accounted sane. With this would be connected all the external sanitary requirements for the maintenance of mental and physical health; and to these advantages would be added a due prudence in respect to marriage, so that marriages would not be contracted until the married had the means necessary for the maintenance of offspring. This is an essential provision, since death in every degree, great or little, is as surely the shadow of birth as the shadow of the twig of a tree upon the ground and the total eclipse of the omnipotent sun are one and the same phenomenon.

Some will say that the method here propounded is too slow in its action to meet pressing emergencies, although it may be a good method when, by a bolder plan, a preliminary reformation has been secured. But I venture to answer that no preliminary reformation is wanted, because the natural reformation covers all the ground, and because every unnatural change which may be established only makes it a harder task to come back to nature. At this moment we may be erring and straying from the right way like lost sheep; but there is the redeeming virtue in the fact that as we are only erring and straying we may be saved, while by other methods we are not merely erring and straying, but are systematically and intentionally going from the right; are not lost sheep but headstrong ones, rushing into dangers infinitely greater than those we are anxious to avoid, and planting roots of evil which it will take ages of learning, wisdom, self-abnegation, and tribulation to remove; planting perdition that we may relieve poverty.

There are other persons who will agree with me on the question of method, but who will hold that the course I would suggest is simply impossible, and one that has never been, even under the most favourable conditions, attainable. To any objection of this kind I reply from direct evidence showing perfect practicability, and that without going into the poetical regions of the past, or out of the immediate history of our own era.

In the little community of Montreux, in the Vaud, in Switzerland, a parish containing 2,833 persons, a pastor there, M. Bridel, kept a record for many years of the social life. It was a model sanitary record. The births were at the rate of one in forty-five, the deaths one in sixty-four, or at the rate annually of 15·62 in the thousand living. The conditions and the consequent health of so favoured a community were sustained by the comparative slowness and circumspection with which the successive generations of human life were brought into the world. There was no method of interruption to the natural life that could lead to any moral wrong; the social state in which the happy circumstances of one generation were handed down to the next generation "was due," says Sir Francis D'Irvenois, who relates the history, "simply to Swiss forethought and to the virtue of continence."

To this picture of a model community let us take a contrast, existent at the same time, and commented on by the same learned authority.

This contrast was found in the Russo-Greek community at Nisni Belgorod, a community of the same size and, if it had willed, of the same morality. Here the births were one in seventeen, the deaths one in twenty five. "Mark," says D'Irvenois, "the figures which announce the proportional mortality of these contrasted communities. In the Russian community one twenty-fifth disappeared annually; in the Swiss one sixty-fourth. The Russian generations passed away more than twice as rapidly as the generations of Montreux. Who would purchase the advantage, equivocal at best, of a triple number of births, accompanied by this enormous number of premature deaths? In Montreux, too, four-fifths of those born reached the age of twenty, whilst in the Russian district out of one thousand baptised six hundred and sixty one perished before their fifteenth year. The nuptial garments of the mothers were the destined shrouds of the first-born. In the Russo-Greek community the march of life, seemingly so fruitful and rapid if it had been calculated by the birth-rate alone, was, in fact the most murderous in Europe. In the Swiss community the march of life, so seemingly slow if estimated by the same

method, was towards health and a steadily and improving vital progress."

These facts stand on record for our guidance in the study of the best means for the storage of life. They teach us the rate of death to the rate of birth under conditions favourable or unfavourable to persistence of life. They show that the advance of a population and its conditions, with regard to subsistence, are (as D'Irvenois most correctly formulated it) universally correlative; and that a state of comfort stands in relation to the rate of increase either as cause or effect. If the rate is rapid, the state of comfort is in relation of cause. If the rate is slow, the state of comfort is its effect. The conditions of ease and the consequent health of the social body sustained at Montreux were due to the comparative slowness and circumspection with which its successive races were brought upon the scene of the world.

As bearing on the storage of life, this lesson, derivable from two diverse populations, is rigidly relevant. If life must be stored fully the first stages of it must be strong and the last stages of it must be long; for it is in the first stages of it that the duration is secured, in the last that it is realized. We must have a good first childhood if we would have a good second childhood; then the full measure of life is secured.

The evidence is also fair that if we could, by our labours in the directions named above, increase the storage of life in the individual, by what may at first seem to be artificial cultivation, we should in the end cultivate the heredity; for this is precisely what nature does in all her vital processes. She stamps everything that is vital and lasting, through time. Time is her means of improvement in both method and work. Time takes the place, unconsciously, of design or purpose to those who do not follow or understand her ways, consciously and clearly to those who do.

It is, in fact, by this very method that nature maintains the balance of life altogether on the earth. When there is rapid production there is rapid death; when there is slow production there is, *cæteris paribus*, slow death. Fewer people, longer life for the few. But slow production is a sanitary measure, and it and the results of it must be the resultant of purely natural causes. Strive by the unnatural to pervert the natural, and though we may succeed in one way we will fail in another. Limit the numbers of a race, limit growth by the imposition of unnatural laws, and the triumph will be the development of a limited population of an abortive type. We see this in local attempts to play the fool with nature. The wise countryman of Celestial soil checks the natural growth of his female child's

feet by binding them firmly up in bandages. He succeeds to perfection, and he produces a cripple. What is true of the local is equally true of the general; a population may be limited in numbers by infringement of natural laws, but the certain result will be that which sanitarians would deem the worst day's work they ever did, the promotion of a crippled race, a diminutive race, in whom the good storage of a good life would be simply an impossibility. This is just what we do not want. We want to raise a race on each of whom every god has set his seal,

"*To give the world assurance of a man.*"

From the study of the topic which lies now before us many questions of practical moment spring, and one above all, namely, how we as sanitary teachers can so proceed as to influence the world towards the adoption of the rule of continency of life? I believe we are already doing that in every effort we make to better the condition of the people of all grades and ranks of life. When we strive to give cleanly and comfortable homes, to find and promote rational amusements, to cultivate and distribute a pure and delightful literature, and to teach those habits which lead to purity of body as well as mind; when we lend ourselves to the maintenance of healthful bodily recreations for members of both sexes; and when we discover and bring into action measures of an innocent and useful character in which the members of both sexes can easily participate without feeling themselves separated by some absurd and supernatural barrier, as if they were human beings of different flesh and blood,—then we are doing the very choicest work for the regeneration of the race, for making it a race that shall be the parent of a greater race, and for checking that overabundance of an inferior race which is the sign and seal of bad blood, and of degraded vital power of body as well of mind.

Let us go on in this course; let us be led into no other, and we shall leave a record which we may, it is probable, never behold, but which will be none the less clear to other eyes, that shall see it when ours are closed for ever.

The Balance of Bodily Functions.

The sanitarian, in the new work which lies before him, can render the most telling assistance to the good storage of life and to the storage to good life, by teaching the first steps, in the early days of the journey of life. But there is another course before him which is not less important, and which relates to the art of training the body in such a form that all parts of it shall be kept in perfect balance and, if I may say so, in equal health.

It has been too much of a rule to look upon the work of the trainer as that of one who is ministering to the amusements of life, or to the simple teaching of those who, for a professional purpose or for amateur display, are about to enter into some trial or competition of strength or of skill; and, indeed, I have heard prudish people object to training on this very ground, that whilst it is all right for those who have to get their living by it, or who wish to show themselves off as particularly clever in winning races or other contests of a physical class, it is out of place in all cases where it is the desire to be well brought up and to be of ordinary good deportment. This, however, is merely putting the cart before the horse. These systematic trainings are just the sort of trainings which actually break the balance of parts, which tend to shorten, and which often do shorten, the vital powers of some of the very best endowed of mankind for the sustainment of a long existence. Such local overtraining is really a worse plan than that of employing no training at all, and is only equal in badness with that training into one kind of exercise by which special organs of the body are forced into quick and mature development before the other organs have reached the same development, or have even reached their maturity. I think it worthy of special comment that in every person of very advanced and healthy life whom I have carefully examined as to the physical state, and as to the state that has led to the longevity, this fact has come out first and foremost—that the organic functions were still acting in proper accord and perfect harmony. A comparatively weak body may thus be seen to have the capacity of storing up a long life and of passing by a much stronger body in the race. This was the actual case in the oldest person who ever came under my own direct observation. On the other side I do not remember any-one of fine and vigourous frame of body and mind who, dying prematurely, did not die from the failure of some one vital organ almost exclusively. As the one shot which strikes the vital spot in a bird is the cause of death, so the one blow or series of blows on one organic structure in the well-built human form is the constant cause of collapse in the premature failure of that form. We have here before us, presented in the most tempting manner, a study second to none in the range of sanitation. It is a study which opens up to us the widest reach of sanitary practice and skill, extending into the daily life of men, women and children of every rank and of every occupation. At present, as a study it is far too loose and crude to be called a branch of knowledge, while too often it is merely offered to the world as a piece of flagrant and transparent quackery, which deceives the ignorant and, like the bone-setting sham in medi-

cine, does an incalculable amount of injury. We have to reduce this method of equal training of the organs of the body for regular and systematic work to a regular and systematic science, so that it may be taught in elementary schools, become a natural part of the national education, and be so impressed, intelligently, on the mind as to be a duty for observance and conduct throughout the whole of life.

It is impossible too strongly to impress the fact that for long storage of life a physical training of the body, that shall secure a uniform strength, is a primary lesson in sanitation. We, as an Institute, ought to take up this question as one essentially in our own domain. It comes most naturally before us, as health in relation to physical movement, and it would form an admirable subject of a special course of lectures: not a mere ephemeral course, but one that should go on from year to year with a constantly improving strain, adapted to the advances, the necessities, and, I may say, the fashions of the age.

The elements of this part of our subject are simple, but none the less effective on that account. We have to keep the public mind open to the fact that a weak and well-balanced body is practically a stronger body than a strong and unbalanced one; that a weak body may by properly balanced training be made one of great power for the retention of life; and that a body of original strength and beauty may be made of unusually long or of unusually short life, according as it is trained into the conditions leading to the one or the other.

Perfected or all round Temperance.

Another aid towards the storage of life is that stoical virtue which may be summed up in the term perfected or all round temperance. I do not include in this term what is commonly understood, abstinence merely from stimulating or alcoholic drinks. Such abstinence is more than half the battle, but it is far from all the battle. The storage of life is reduced by intemperance of speech, of action, and even of thought. We may consider that whatever quickens the action of the heart beyond its natural bounds is a form of intemperance. In our present stage and mode of existence the heart is fitted in each individual, according largely to his heredity, to do a certain amount of work, to beat a certain number of beats, to perform the feat of distributing daily a certain number of foot tons of blood over the body, and then of finishing its course or career. It is probable that in the work thus carried out nothing is ever recalled. So much done, so much lost. The heart may wear out in its own structure by changes of disease going on there, and that adds to

the evil, but I deal now with this ever-working organ in its natural state, as dying out simply by its own work, and it is by so studying it that the difficulties now being considered come into view. Stimulation of various kinds, hastening the decline of power, thus comes into operation and the organ fails under it. Our good and useful friend the postman feels it from the excess of his work on foot; the doctor or nurse feels it when obliged to forfeit the natural time of sleep; the man in the money market feels it when, for that which is not bread, he lets his excitement of sale or purchase carry his heart away into wild hope or wilder despair; the man of unbridled passion, who grows pale or red with rage, feels it to the extremest tension and is almost invariably cut short in his career, long before it is at its natural fulfilment, by this fact of cardiac wear alone. Beyond all these the jealous man feels it and literally corrodes into broken heart long before the proper period for which he was constructed, for of all moral excitements jealonsy is the most fatal. It constitutes a distinctive disease.

These are stimulations excited by and through the mind; but to them we must of course add others of grosser quality springing from the improper use of foods and drinks. Here, in regard to foods, there lies before us a wide field for research, for up to the present time there has been very little discovered that can be trusted as proved. That our various tissues are constructed from the foods we take, every school boy and girl is now taught; but what foods are best fitted for the special tissues and parts the most advanced physiologist is not able to say with any of that precision of knowledge which is so urgently required. For instance: there is one tissue of our bodies that is of first and greatest moment, I mean the elastic rubber like tissue which gives elasticity to the lungs, to the arteries throughout all their course, and to some of the important membranous surfaces. If in the lung structure this elastic tissue fails a large share of the expirating function of the lung fails, and Dr. Francis Troup, of Edinburgh, in a splendid paper communicated to the *Edinburgh Medical Journal*, on the detection of pulmonary consumption by the microscope, has lately told us that the presence of the curly filaments of this tissue in the fluid expectorated by the patient is one of the earliest evidences of disintegration of the pulmonary organs. We all see the effects of the degeneration of this elastic structure in the differences of youth and age. We speak of the elasticity of youth, the rigidity of age. We speak figuratively it will be said. No! we speak actually; for we are merely describing differences dependent purely on the condition of this veritable elastic tissue. The knowledge as far as it goes is good. We know the qualities of this tissue; I have myself vulcanised it as

caoutchouc is vulcanised: we know its chemical composition; we know that it must originally be derived from food; but where and how it is constructed in the body, why it is so largely supplied and is so active in quality in the young body, so deficient and inactive in old, we have no clear ideas whatever. We do not know what foods feed this tissue, what diminish it. We do not even know the elementary facts whether it is made at all after birth, or whether we are born, so to speak, with a store of it, which is left to wear out and is never recuperated. On all this matter of feeding, therefore, we have as sanitarians, much to learn, and in this direction of learning we have as a primary duty to determine the most primitive of all questions, whether it is wise to use up as food the half-used-up tissues of the lower animals, or whether we should go direct to the vegetable world for our supplies and never swerve from that course.

I expect, and I say this as a partial animal feeder, that for the storage of life the primary or vegetable source is the soundest and best, and that in time, for the sake of the economy of life, as well as of the economy of money and of suffering, as a human family under the determination to live long and healthily and happily, we shall come back to the first fruits of the earth.

Turning to the drinks which are necessary for perfecting the storage of life, I could say a great deal and shall say little. It would not be becoming of one whose views are so well known as mine to belabour you here with any long observations on the subject of temperance in regard to those fluids which by some wretched adventure of poor humanity in its puerile stage crept into use in certain sections of the world as drinks exciting and vinous. But I may say that we may congratulate ourselves that their use has never extended beyond the human family, and that if the fish of the sea had discovered them the theory of Van Leeuwenhoek had never even to his fertile mind had any foundation. We may congratulate ourselves also as a human family that, except under the most degraded conditions, we are born abstainers from them, and live for our few first years protected from their action. Regarding this action and its influence on the storage of life I should however be carrying complacency into cowardice did I not add further that from the beginning to the end of the chapter the influence of alcohol on all the mechanism of the body that demands most care is towards deterioration and cessation of action, and this so determinately that a race could be produced under its baneful influence in which an artificial natural state—it is no paradox—should bring about a fixed lower limit of storage of life, a limit that should not represent, as its standard of duration, one-fourth

of that which is now well known as the comparatively easily attainable duration.

Prevention of Damaging Diseases.

The existence amongst men of certain diseases which lead to physical damage and deterioration, and to the reduction of the capacity for the storage of life, is the last subject to which there is time to refer. Putting aside diseases which kill so often right off the reel, but which may not leave any very serious damage in instances in which there is recovery from them, there are some which in the most conspicuous manner prevent the possibility of complete storage not alone in one but through many generations. The alcoholic diseases, the scrofulous and phthisical, the malignant or cancerous, the syphilitic, are, prominently, diseases of this order; and whoever in the sanitary line of research helps to remove them by getting at and removing their causes is amongst the truest friends of humanity that humanity ever possessed.

As against the whole argument of the storage of life, an objection may, I know, be made, that such storage is, after all, not worth having, and that a short life and a merry one is the golden rule. This theory, of the butterfly order, is pretty, but, brought to the proof, is the most miserable practice that the eye of man can see or his ear hear. The men who say it most feel its acute folly also most. When the mind and body are worn out, when there is forgetfulness of things, friends, and events, then, no doubt, the continuance of life is no longer desirable. But between the commencement of the last stage of a long life and the establishment of the complete stage there may be, and often is—nay, always is when the process is healthy—a time of actual pleasure, during which the survey of the past and the recollection of the past are sources of the most peaceful and exalted happiness. For, as in the healthy first period of life hope is the spring, the mainspring of life, so in the last period, when that is healthy, realisation is the note of success and satisfaction. Moreover, in some well-constituted bodies and minds, the actual winter of life is fruitful, nay positively rich in doing and in well-doing, without the fever and intense aspiration of youth, but with the force which springs from knowledge that has ripened, and wisdom that has fortified knowledge. We have amongst us at this very moment one who

has been for three parts of a century a giant in our great cause, and who in the period of life coeval with the century, instead of being tired of life and of work, enjoys both to his heart's content. Need I go one step further in search of an exemplar, and that a living one, of my argument? I need not. I will leave, literally as well as figuratively, the proof of the argument with the Chairman.

The Chairman, Mr. Edwin Chadwick, at the close of the address, said: I beg to move a vote of thanks to Dr. Richardson for the great discourse you have heard from him to-day. I venture to add, that the power of sanitation has so far advanced that contractors might contract, for the advancement of the duration of life, for some years; at once for the advancement of the duration of life of the average of all who hear me and who are resident in the Metropolis, by some five years or more. I might present some notion of the gain of life practicable, by showing what is little known, and is difficult to get entertained as charges for malfeasance, that the loss of life and of money in this Metropolis, even with its present reduced death-rate, by errors in legislation, and by culpable maladministration, amounts in this Metropolis to not less than 90 lives, and not less than £15,000 every day; and for every year to not less than 35,000 lives, and upwards of five millions and a half in money. On the other hand, I might present examples of more correct applications of the principles of sanitation where the death-rates of cities and towns have been reduced by more than one-half, and where a corresponding gain in life and money has been achieved. I might adduce examples of the total abolition of the so-called children's diseases, and a reduction to one-third of the children's ordinary death-rates. On such grounds large future augmentations of octogenarians and nonagenarians' life may be anticipated from the reduction of the wastefulness of political ignorance. It certainly appears that the larger proportions of centenarians are amongst the lower and generally depressed classes; but among those in exceptionally healthy neighbourhoods and the absence of overcrowding, and always connected with hereditariness, and generally with very simple lives, which will be one great sanitary factor.

APPENDIX.

EXAMINATIONS IN SANITARY SCIENCE FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

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Registrar.

G. J. SYMONS, F.R.S.

THE great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances in connection with the various Acts relating to Public Health, the Sale of Food and Drugs, &c., led the Council of the Sanitary Institute of Great Britain to establish Voluntary Examinations, to appoint a Board of Examiners, and to grant Certificates of Competency in Sanitary knowledge.

The Examinations are arranged in two grades, and are intended to enable Local Surveyors and Inspectors of Nuisances, or persons desirous of becoming such, or of obtaining the Certificate of the Institute, to prove their competency in the subjects of Examination. A register of Successful Candidates is kept at the Offices of the Institute, and a copy will be forwarded to Local Boards and Sanitary Authorities on application.

Each Examination occupies a portion of two days. On the first day the Examination of Surveyors occupies four hours—viz., from 11 a.m. till 1 p.m., and from 4 till 6 p.m., and consists of written papers only. Inspectors of Nuisances have two hours' written examination on the first day—viz., from 1.30 till 3.30 p.m. On the second day the Examination, for both classes, commences at 11 a.m.,

and is *vivâ voce*, with one or more questions to be answered in writing, if deemed necessary. A Certificate of Competency, signed by the Examiners, is granted to successful Candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

As one person may, under the Public Health Act, 1875, be both Local Surveyor and Inspector of Nuisances, the Examinations are so arranged that Candidates who desire to do so, *can* enter for both Examinations on the same occasion, but they are not advised so to do.

Every Candidate is required to furnish the Board of Examiners with satisfactory testimonials as to personal character, and to give two weeks' notice previous to presenting himself for Examination, stating whether he wishes to be examined as Surveyor, as Inspector of Nuisances, or as both. The fee for Examination must be paid to the Secretary, by Post-Office order or otherwise, at least six days before the day of Examination. On the receipt of the fee, a ticket will be forwarded admitting to the Examination.

The fees payable for the Examinations are as follows :—

As Surveyor	£5 5s.
As Inspector of Nuisances . .	£2 2s.

Unsuccessful Candidates are allowed to present themselves a second time without additional payment.

Examinations are appointed to be held for the year 1888 :—

On Thursday and Friday, June 7th and 8th.
On Thursday and Friday, November 8th and 9th.

The Forms to be filled up by Candidates and their recommenders previous to Examination will be supplied on application to the Secretary, 74A, Margaret Street, W.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities, as far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

Sewerage and Drainage—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Sewerage works; the ventilation and flushing of sewers and drains; the internal drainage and other Sanitary arrangements of houses, privies, water-closets, dry-closets, and the removal of refuse; the Sanitary details of Builders' and Plumbers' work.

Water Supply of Towns and Houses—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of, Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

Regulation of Cellar Dwellings and Lodging Houses—General principles of Ventilation; the amount of air and space necessary for men and animals; the means of supplying air, and of ensuring its purity.

Highways and Streets—The Sanitary principles which should be observed in the construction and cleansing of streets and roads.

All persons who have passed the above Examination and received the Certificate for Local Surveyors are, by virtue of having so passed, entitled to become Life Members of the Institute, upon payment of Five Guineas, in addition to the fee paid for the Examination.

FOR INSPECTORS OF NUISANCES.

A thorough knowledge of the Provisions of the Acts and Model Bye-Laws relating to the duties of Inspector of Nuisances—also of the working of the Sale of Food and Drugs Act.

A fair knowledge of the principles of Ventilation, and the simple methods of Ventilating Rooms—Measurement of Cubic Space.

A knowledge of the Physical Characteristics of Good Drinking Water—the various ways in which it may be polluted, and the means of preventing pollution—Methods of Water Supply.

A knowledge of the proper conditions of good drainage.

The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' work.

A knowledge of what constitutes a Nuisance, arising from any Trade, Business, or Manufacture.

A fair knowledge of the characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables), so as to be able to recognise unsoundness.

Some knowledge of Infectious Diseases, and of the Regulations affecting persons suffering, or recovering, from such diseases.

A knowledge of the best Methods of Disinfection.

Methods of Inspection, not only of Dwellings, Cellar Dwellings, Dairies, and Milk-Shops, but of Markets, Slaughter-Houses, Cow-Sheds, and offensive Trades.

Scavenging and the Disposal of Refuse.

All persons who have passed the above Examination and received the Certificate for Inspectors of Nuisances are, by virtue of having so passed, entitled to become Life Associates of the Institute, upon payment of Three Guineas, in addition to the fee paid for the Examination.

EXAMINATIONS FOR LOCAL SURVEYORS AND INSPECTORS OF NUISANCES.

The following Candidates received Certificates from June, 1887, *to June*, 1888.

LOCAL SURVEYORS.

1887, Nov. 11, Campbell, Adam H., Edinburgh.
1888, June 8. Darch, John, Balham.
1887, June 3, Geen, Harry, Okehampton.
1887, Nov. 11, Hunt, John W., Newport, Mon.
1888, June 8. Lowther, Thomas, Bristol.
1887, Nov. 11, Macdonald, Donald G., Douglas, Isle of Man.
1887, June 3, Railton, James, Kilmarnock, N.B.
1887, June 3, Spurrell, Herbert, Eastbourne.
1887, June 3, Thomas, W. E. Clason, Neath.

INSPECTORS OF NUISANCES.

1888, June 8, Adams, H. J., Wandsworth.
1887, Nov. 11, Addiscott, William J., Plymouth.
1887, June 3, Allen, William H., Cardiff.
1888, June 8, Amor, Daniel Clement, Fremantle, Southampton.
1887, Nov. 11, Aris, F. A., Liverpool.
1887, Nov. 11, Bell, Robinson, Carlisle.
1888, June 8, Bishop, William F., Bristol.
1888, June 8, Boothman, Henry, Whitworth, near Rochdale.
1888, June 8, Boyce, William, Clapton Park, E.
1887, June 3, Broadhead, Samuel, Bootle, near Liverpool.
1887, June 3, Brown, R. Railston, Bridlington Quay.
1887, June 3, Brown, William Edward, Hastings.
1888, June 8, Bryant, Charles A., Huntingdon.
1887, Nov. 11, Butland, R., Brighton.
1888, June 8, Catten, Joseph H., Exeter Street, Sloane St., S.W.
1888, June 8, Clarkson, Joseph, Southport.
1887, June 3, Cobham, Charles, Gravesend.
1887, June 3, Cooper, William George, Brighton.
1888, June 8, Cordon, Robert Curtis, Newark.
1887, June 3, Cowper, Joseph, Brixton, S.W.
1888, June 8, Cox, James H., Hailsham.
1887, June 3, Curtis, W. E., Ilford, Essex.
1887, Nov. 11, Devey, W. S., Birmingham.

1887, June 3, Dunbar, David, Aberdeen.
1888, June 8, Dyson, John Henry, Thornhill, near Dewsbury.
1888, June 8, Edmonds, William H., Camden Town, N.W.
1887, June 3, Edwards, John White, Birkenhead.
1888, June 8, Evington, C. W., Hull.
1888, June 8, Fincher, J. G., Aldershot.
1887, Nov. 11, Flower, T. J. M., Bristol.
1887, Nov. 11, Fordham, W. F., Willesden.
1887, Nov. 11, Gardner, C. T., Dock Street, E.
1888, June 8, Gardner, James Thomas, Gravesend.
1888, June 8, Geary, Reginald, Hampstead.
1888, June 8, Gillespie, A., Lees, near Manchester.
1887, Nov. 11, Golds, Thomas W., Brighton.
1887, Nov. 11, Grant, W., Eastbourne.
1888, June 8, Harrison, William Lowther, Hull.
1888, June 8, Head, R. Heath, Upper Baker Street, W.
1887, June 3, Higgins, John W., New Brighton.
1887, Nov. 11, Hilliam, H., Stamford.
1888, June 8, Hills, Arthur R., Bow, E.
1888, June 8, Hobbs, W. F., Staleybridge, near Manchester.
1887, Nov. 11, Houghton, R. A., Birkenhead.
1887, Nov. 11, Hoy, P., Dudley Place, W.
1887, June 3, Hunt, John W., Newport, Mon.
1887, June 3, Hunt, William E., Bromley, Kent.
1887, June 3, Jackling, W., Hull.
1887, Nov. 11, Jasper, R. W., Woodford Green.
1887, June 3, Johnson, Robert, Whitby.
1887, Nov. 11, Jones, D., Swansea.
1888, June 8, Jones, James, Cefn Coed, near Merthyr Tydfil.
1888, June 8, Jours, William, Gateshead.
1888, June 8, Kett, Philip, Lowestoft.
1887, June 3, Kiell, John, Barnstaple.
1887, June 3, King, Frederic William, Maldon.
1887, Nov. 11, Kitchen, Tom A., Leeds.
1888, June 8, Knight, W. H., Wandsworth, S.W.
1888, June 8, Lander, James, Holloway, N.
1888, June 8, Lawrence, Frank J., Beckenham.
1887, Nov. 11, Lear, James W., De Beauvoir Town, N.
1887, Nov. 11, Lee, W.
1887, June 3, Leighton, Joseph William, Birmingham.
1887, June 3, Lewis, Arthur, Wellingborough.
1888, June 8, Lock, G. H., Cardiff.
1888, June 8, Lund, Jeremiah, St. James's Vestry, Piccadilly.
1887, Nov. 11, Macdonald, Donald G., Douglas, Isle of Man.
1888, June 8, Mackenzie, F. Morell, Hans Place, S.W.
1888, Nov. 11, McNair, Alexander, Holloway, N.
1887, June 3, Mathias, Henry D., Liverpool.
1887, June 3, May, W. H., Hampstead, N.W.
1887, June 3, McCulloch, Robert James, Bootle, near Liverpool.
1888, June 8, Milne, Edward, Heywood, Lancashire.

1887, Nov. 11,	Minty, S., Bournemouth.
1887, June 3,	Munro, W., Diss, Norfolk.
1888, June 8,	Nesfield, William, Scarborough.
1887, June 3,	Nurcombe, Benjamin, West Brighton.
1888, June 8,	Oldfield, David, Walton, near Ipswich.
1887, Nov. 11,	Patrick, A. R., Farnham.
1887, June 3,	Pattison, W. P., Sunderland.
1887, Nov. 11,	Perry, A., Marylebone.
1887, Nov. 11,	Pettit, G. M., Anerley.
1887, June 3,	Potter, E. J., Brighton.
1888, June 8,	Powell, John, Neath.
1888, June 8,	Pratt, J., Sydenham.
1887, June 3,	Price, G., Liverpool.
1887, June 3,	Ramsdale, W. G., Ruswarp, near Whitby.
1887, June 3,	Readman, William, Whitby.
1888, June 8,	Richardson, W., Fence Houses, Durham.
1887, June 3,	Robinson, James, Sunderland.
1888, June 8,	Rogers, Richard, Carnarvon.
1887, June 3,	Rudland, Thomas, Sunderland.
1888, June 8,	Rugg, John Edward, Bow.
1887, June 3,	Samuel, James, Egremont, Cheshire.
1888, June 8,	Shawcross, James Thomas, Withington, near Manchester.
1887, June 3,	Sheldon, William Edwin, Wantage.
1887, Nov. 11,	Shelton, J., Brighton.
1887, June 3,	Sidwell, Henry Thomas, Cholsey, nr. Wallingford.
1887, June 3,	Sleath, Frederick Edward, Harlesden, N.W.
1888, June 8,	Smith, George Allen, Hampstead.
1887, June 3,	Stanley, A. W., Jun., Hull.
1887, June 3,	Stevens, George, Godmanchester.
1888, June 8,	Stevenson, John, Kingston-on-Thames.
1887, Nov. 11,	Stewart, T. D., Dunoon, N.B.
1887, June 3,	Sumner, James W., Great Driffield.
1887, June 3,	Tattersall, R., Accrington.
1887, Nov. 11,	Taylor, James, Hereford.
1888, June 8,	Temple, William Herbert, Scarborough.
1887, June 3,	Thomas, Evan Charles, Pontycymner Garw Valley, S. Wales.
1887, Nov. 11,	Thomas, Thomas, Bristol.
1887, June 3,	Thomas, William Kingdon, Clifton, Bristol.
1887, Nov. 11,	White, Robert, Birmingham.
1888, June 8,	White, Thomas, Culworth, Banbury.
1887, June 3,	White, William Owen, Banbury.
1888, June 8,	Wild, John, Rochdale.
1887, June 3,	Wilkinson, George H., Liverpool.
1888, June 8,	Willey, Andrew W., St. George's-in-the-East.
1887, Nov. 11,	Winter, Edward, Brighton.
1888, June 8,	Woonton, J., St. George's-in-the-East.
1887, Nov. 11,	Yeo, W., Brighton.
1887, June 3,	Young, A. F., Monkwearmouth.

EXHIBITIONS OF SANITARY APPARATUS AND APPLIANCES.

The Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Patents Designs and Trade Marks Act, 1883.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of Merit to such objects as they may consider worthy.

In addition to the Ordinary Medals, a special Medal—the Richardson Medal—is offered by the Institute, for a selected exhibit from the entire exhibition, and will be awarded by the Judges in cases of pre-eminent merit only. Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such trials subsequent to the close of the Exhibition.

The Exhibits are arranged in the following Classes:—

CLASS I.—Building Materials, Construction and Machinery.

Sec. 1.—Materials and Construction.
„ 2.—Damp-proof Courses.
„ 3.—Paints & other Protectives.
„ 4.—Wall Papers and Coverings.
„ 5.—Flooring.
„ 6.—Decorative Materials.
„ 7.—Machinery and Mechanical Appliances.
„ 8.—Laundry Appliances.

CLASS II.—Water Supply and Sewerage.

Sec. 1.—Apparatus for Water Supply.
„ 2.—Filtering & Softening Water.
„ 3.—Water Waste Preventers.
„ 4.—Flushing and Watering.
„ 5.—Sinks.
„ 6.—Baths and Lavatories.
„ 7.—Water Closets.
„ 8.—Urinals.
„ 9.—Sewers, Drain Pipes, and Accessories.
„ 10.—Traps and Gullies.
„ 11.—Dry Closets.
„ 12.—Sewage Treatment.
„ 13.—Miscellaneous Sanitary Goods.

CLASS III.—Heating, Lighting and Ventilating.

Sec. 1.—Heating Apparatus.
„ 2.—Cooking Apparatus.
„ 3.—Smoke Preventing Appliances.
„ 4.—Lighting, including Electric Lighting.
„ 5.—Ventilating Gas Burners.
„ 6.—Ventilators.

CLASS IV.—Personal Hygiene, Foods, Filters & Disinfectants.

Sec. 1.—Clothing.
„ 2.—Beds and other Furniture.
„ 3.—Hospital and Sick-room Appliances.
„ 4,—Domestic Appliances.
„ 5.—School Fittings.
„ 6.—Gymnastic Apparatus.
„ 7.—Foods.
„ 8.—Domestic Filters,
„ 9.—Mineral Waters.
„ 10.—Soaps and other Detergents.
„ 11.—Antiseptics & Disinfectants.
„ 12.—Disinfecting Apparatus.

CLASS V.—Miscellaneous.

Articles of Sanitary interest not included in the above Classes, such as:—

Sec. 1.—Scientific Instruments.
„ 2.—Books and Periodicals
„ 3.—Prevention of Accidents.
„ 4.—Respirators & Face Guards for Unhealthy Occupations.
„ 5.—Fire Preventing Appliances.
„ 6.—Methods for the Disposal of the Dead, &c., &c., &c.
„ 7.—Sundries.

EXHIBITIONS HELD IN CONNECTION WITH THE CONGRESSES OF THE INSTITUTE.

	1877. Leamington.	1878. Stafford.	1879. Croydon.	1880. Exeter.	1882. Newcastle.	1883. Glasgow.	1884. Dublin.	1885. Leicester.	1886. York.	1887. Bolton.
Number of Exhibitors	117	116	189	106	110	126	134	135	130	112
Number of Exhibits	294	319	710	500	600	750	900	1,000	900	800
Space occupied (in square ft.)	......	......	......	9,725	14,520	20,000	40,000	30,000	30,000	25,000
Number of days Exhibition was open	14	16	17	19	25	25	19	17	26	29
Total number of Visitors	......	......	......	8,955	8,373	20,000	35,000	37,000	30,000	27,000
Number of Medals awarded	13	13	12	12	15	21	18	34	16	14
Number of Special Certificates	None.	6	9	7	4	13	11	11	12	9
Number of Certificates	None.	22	38	40	72	58	83	79	64	40
Number of Exhibits deferred for further trial	......	7	52	30	37	44	39	119	42	46

CLASSIFIED LIST OF THE AWARDS AT THE EXHIBITIONS.

EXPLANATORY NOTE.

The letter **M**, followed by the date in heavy type, signifies a Medal.

The letter **C***, followed by the date in heavy type, signifies a Special Certificate, given for an exhibit to which a Medal has been awarded at a previous Exhibition.

The letter C, followed by the date in ordinary type, signifies a Certificate.

In each case the date indicates the year in which the award was made.

The Town in which the Exhibition was held in each year is shown in the following list:—

1877. Leamington.
1878. Stafford.
1879. Croydon.
1880. Exeter.
1882. Newcastle.
1883. Glasgow.
1884. Dublin.
1885. Leicester.
1886. York.
1887. Bolton.

Where the name of the Exhibitor is in *italics* it implies that he is also the Inventor or Manufacturer of the Exhibit.

CLASS I.—BUILDING MATERIALS, CONSTRUCTION AND MACHINERY.

Section 1. Materials and Construction.

1. Aluminium Crown Metal. *Aluminium Crown Metal Co.* **M, 1883.**
2. Delta Metal. Alex. Dick. **M, 1883.**
3. Artistic Domestic Ironwork. *Elgood Bros.* **M, 1885.**
4. Granite Vitrified Bricks and Paving. *Candy & Co.* C, 1880.
5. Red Building Bricks. *E. Smith & Co.* C, 1885.
6. ,, ,, ,, *Whitwick Colliery Co.* C, 1885.
7. Rock Buff Facing Bricks. Broad & Co. C, 1885.
8. Salt Glazed Bricks. *Wortley Fire Clay Co.* C, 1886.
9. Silica Glazed and Enamelled Fire Clay Bricks and Fäience. *Willcock & Co.* **M, 1879.**
10. White Enamelled Bricks. *Bourtreehill Coal Co.* C, 1884.
11. ,, ,, ,, *J. & M. Craig.* C, 1884.
12. ,, Glazed Bricks. *Wortley Fire Clay Co.* C, 1886.
13. ,, ,, Facing Bricks. Broad & Co. C, 1885.

CLASS I.—SECTION 1.—*Continued.*

14. Barrow Blue Lias Hydraulic Lime. *J. Ellis & Sons.* **M, 1885.**
15. Terra Cotta, Exhibit of. *Whitwick Colliery Co.* C, 1885.
16. Hygeian Rock Building Composition. *William White.* C, 1882.
17. Silicate Cotton. J. A. G. Ross. **M, 1882.**
18. Scottish Asbestos. *Scottish Asbestos Co.* **M, 1883.**
19. Victoria Artificial Stone Paving. *Patent Victoria Stone Company.* **M, 1885.**
20. The Croft Artificial Stone Paving. *Croft Stone Quarry & Brick Co.* C, 1885.
21. Damp-proof Concrete Pavement. *W. B. Wilkinson & Co.* **M, 1882.**
22, Granite Concrete Pavement. *T. Cordingley & Sons.* C, 1884.
23. Vitreous Floor Tiles. *E. Smith & Co.* C, 1886.
24. Willesden Paper Roofing. *Waterproof Paper & Canvas Co.* **M, 1886.**
25. Willesden Waterproof Paper and Canvas. W. Carson & Sons. C, 1884.
26. Fire-Proof Fixing Blocks. *Wright & Co.* C, 1886; C, 1887.
27. Silicon Tread for Steps. *Doulton & Co.* C, 1883; C, 1884; C, 1885.
28. Dœker Portable Hospital. *Dœker Hospitals & Huts Factory.* **M, 1886.**
29. Glazing Without Putty, System of. *Pennycook Patent Glazing & Engineering Co.* C, 1883; C, 1884.
30. Revolving Shutters, with Balance-Weight Motion. *Salmon, Barnes & Co.* C, 1880.
31. Opener for Fanlights and Skylights. *W. & R. Leggott.* C, 1883; C, 1884; **M, 1885; C*, 1886.**
32. Fanlight Openers and Casement Fasteners. *R. Adams.* C, 1879.
33. Adjustable Pivot for Fanlights. *R. Adams.* C, 1884.
34. Side Gussets for Fanlights. *R. Adams.* C, 1885.
35. Acme Door Check and Spring (double action). Hindle, Norton & Co. C, 1886; C, 1887.
36. Adjustable Shoe and Regulating Spring Hinge for Swinging Doors. *R. Adams.* C, 1879.
37. Norton Door Spring. R. Adams. C, 1884.
38. Victor Spring Hinge. R. Adams. C, 1885.
39. Removable Rain Water Pipe. *J. Gregson.* C, 1887.
40. Sanitary Dry Lime. *Sanitary Dry Lime Co.* C, 1886.

Section 2. Damp-Proof Courses.

No Awards.

Section 3. Paints and other Protectives.

1. Griffith's Patent White. *Silicate Paint Co.* **Richardson Medal, 1878.**

2. Griffith's Patent White, and for their preparations of Silicate Paint, Enamel Paint and Petrifying Liquid. *Silicate Paint Co.* **M, 1878.**
3. Leadless "Charlton White" Paint and Dryers. *J. B. Orr & Co.* **M, 1883.**
4. Arcanum Process of Silver Plating Steel. *Jefferson Read.* **M, 1879.**
5. Magnetic Oxide Paint. *H. Thompson & Co.* C, 1885.

Section 4. Wall Papers and Coverings.

1. Paper Hangings free from Arsenic. *Woollams & Co.* **M, 1879; C*, 1882; C*, 1883.**
2. "Lincrusta Walton." *F. Walton & Co.* C, 1883.
3. Cheap Artistic Non-Arsenical Washable Wall Papers. *Thos. Dockrell, Sons & Co.* C, 1884.

Section 5. Flooring.

1. Peto Fireproof Flooring. *Doulton & Co.* **M, 1885; C*, 1887.**
2. Economic Hollow Flooring. *G. E. Pritchett.* **M, 1878; C*, 1879.**
3. Hospital Flooring. *T. Jennings.* C, 1885.
4. Method of Wood Block Flooring. *Nightingale & Co.* C, 1885; C, 1886.
5. Parquet Flooring. *A. Gardner & Son.* C, 1883.
6. Solid Oak Parquet Flooring. F. R. Scott & Co. C, 1884.
7. Immovable "Acme" System of Solid Wood Block Flooring. *Duffy & Son.* C, 1886.
8. "Through-colour" Linoleum. *Hembry & Co.* C, 1887.

Section 6. Decorative Materials..

1. Repoussé and other Brass Work, Exhibit of. *W. F. Johnson.* C, 1885.
2. Colouring Patterns through the Substance of Wood. *H. Chalk Webb.* **M, 1880.**
3. Moulded Wood Decoration. *J. F. & G. Harris.* **M, 1886.**
4. Art Pottery. *Doulton & Co.* **M, 1884; C*, 1885.**
5. Improved Fibrous Plaster Work. *T. Cordingley & Sons.* C, 1886.
6. Architectural Terra Cotta, Exhibit of. *J. Stiff & Sons.* C, 1885.
7. Decorative Tiles for Covering Walls and Floors. *Doulton & Co.* C, 1879.
8. Embossed Tiles. *E. Smith & Co.* **M, 1885.**
9. Hall's Hanging Tiles. *J. Cliff & Sons.* C, 1886.

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS I.—SECTION 6.—*Continued.*

10. Marsden Tiling for Wall Decoration. Maguire & Son. C, 1884.
11. Photographic Embossed and Incised Tiles. *E. Smith & Co.* C, 1885.
12. Wedgewood Ornamental Tiles. W. B. Morrison. **M, 1883.**

Section 7. Machinery and Mechanical Appliances.

1. Chain Belting for Machinery. W. Wilby. C, 1884.
2. Cotton Machine Belting. *Maurice Gandy.* C, 1883; **M, 1884.**
3. Steil's Fastener for Machine Belting. Maurice Gandy. C, 1883.
4. Faija's Cement Testing Machine. Casebourne & Co. **M, 1886.**
5. Alcazar Vertical Steam Engine. *E. S. Hindley.* C, 1886.
6. Fryer's Destructor and Carbonizer, and Firman's Desiccating Apparatus. *Manlove, Alliott, Fryer & Co.* **M, 1882.**
7. Improved Six-Ton Steam Road Roller. *Aveling & Porter.* **M, 1879.**
8. Non-Absorbent Tub or Pail Van. *J. B. McCallum.* C, 1880.
9. Steel Wheel for Sanitary Carts. *H. J. Barrett.* C, 1886.
10. Closed Sectional Sanitary Van. *J. Smith & Sons.* C, 1886.
11. Conical Knitting Machine. T. Coltman. C, 1885.
12. Flat Web Knitting Machine and Rothwell Knitting Machines. *W. Rothwell.* **M, 1884.**
13. Friction Driving Attachment for Sewing Machines. *Singer Manufacturing Co.* **M, 1883.**
14. Knitting Machines. *Harrison Patent Knitting Machine Co.* C, 1884.
15. Victoria Knitting Machine. Pim Bros., Limited. C, 1884.
16. Revolving Shuttle for Sewing Machines. *Bradbury & Co.* C, 1883.
17. Power Knitting Machinery. *W. Rothwell.* **M, 1887.**
18. Gun-metal Boiler Fittings. *J. Galloway.* C, 1887.
19. Sight Feed Lubricator. J. Galloway. C, 1887.
20. Johnston's Dryer. *Manlove, Alliott, Fryer & Co.* **M, 1887.**
21. Corrugated Steel Tyre. *William Fox.* **M, 1887.**

Section 8. Laundry Appliances.

1. Improved Washer, with table complete. J. Borwell, **M, 1877.**
2. New "Shuttle" Steam Power Washing Machine. *T. Bradford & Co.* **M, 1877; C*, 1878.**
3. Paragon Washing Machine, with Canadian Washer. Kirsop & Co. C, 1882.
4. Paragon Washing Machine, with Canadian Washer. *E. N. Kenworthy & Co.* C, 1885; C, 1886.
5. Steam Washer. *J. Greenall.* **M, 1885; C*, 1886; C*, 1887.**

6. "Vowel E" Bradford's Family Washing Machine. Garton & King. C, 1880.
7. Washing Machines. *T. Bradford & Co.* **M, 1882**; **C*, 1883**; **C*, 1884**; **C*, 1885.**
8. Washing Machine, heated by Gas. *Thomas Fletcher.* C, 1885.
9. Mitchell's Patent Steam Washer. *James Mitchell.* C, 1882.
10. Eclipse India Rubber Wringer. *E. N. Kenworthy & Co.* C, 1886.
11. Equipoise Wringing and Mangling Machine. *E. N. Kenworthy & Co.* **M, 1886.**
12. White Enamelled Fireclay Laundry Trough. *Bourtreehill Coal Co.* C, 1884.

CLASS II.—WATER SUPPLY AND SEWERAGE.

Section 1. Apparatus for Water Supply.

1. Hose Reel. *Headley & Sons.* C, 1879.
2. Hydraulic Ram. W. Baird. C, 1884.
3. Buck's Automatic Rain-Water Separator. *C. G. Roberts.* **M, 1882**; **C*, 1883.**
4. Anti-percussion High-Pressure Valves. *Doulton & Co.* **M, 1879**; **C*, 1880**; **C*, 1883**; **C*, 1884.**
5. Anti-percussion High-Pressure Bib Valves. *Doulton & Co.* C, 1882.
6. Anti-percussion Ball Valve. *Doulton & Co.* **M, 1882.**
7. Double Valves for Flow and Return in Hot Water Circulation. *Goode & Co.* C, 1885.
8. Improved Paragon Valve. W. Ross. C, 1883.
9. Bib Valves for Hot and Cold Water. *H. Trott.* C, 1885; C, 1886.
10. Full Way Stop Valve. *J. Tylor & Sons.* C, 1880.
11. Large Way Waste Plug, with Protective Cover. Finch & Co. C, 1879.
12. Water Taps. *J. Fell & Co.* C, 1882.
13. Lever Nut for Boiler Cock. *J. Warner & Sons.* C, 1885.
14. Improvements in Well Sinking Apparatus. *Le Grand & Sutcliff.* **M, 1877**; **C*, 1879.**
15. White Enamelled Fire-Clay Cistern. *Bourtreehill Coal Co.* **M, 1885.**

Section 2. Filtering and Softening Water.

1. Anti-Calcaire Powders for Softening Water. *P. A. Maignen.* C, 1883.
2. Porous Carbon for Filtering Water. *Patent Porous Carbon Co.* C, 1885.

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS II.—SECTION 2.—*Continued,*

3. Material for Filtering Water. *International Water & Sewage Purification Co.* **M, 1887.**

Section 3. Water Waste Preventers.

1. Bath Locking Valves for Preventing Waste of Water. *Doulton & Co.* C, 1882.
2. Bath Locking Valves for Preventing Waste of Water. *J. Tylor & Sons.* C, 1882.
3. Direct Acting Valveless Waste Preventer. *A. T. Bean.* **M, 1880; C*, 1882.**
4. Siphon Action Water Waste Preventers. *Shanks & Co.* **M, 1884.**
5. Siphon Action Water Waste Preventer. *H. Braithwaite & Co.* C, 1886.
6. Siphon for Water Closet Cisterns. *H. Braithwaite & Co.* C, 1879.
7. "Waste Not" Regulator Valve. *J. Tylor & Sons.* C, 1880; C, 1882.
8. Waste-Preventing Flushing Siphon. *Henry Watson & Son.* C, 1882.
9. "Invicta" Flushing Cistern. *Goode & Co.* C, 1885.
10. Siphon Flushing Cistern. *Humpherson & Co.* C, 1885.
11. ,, ,, ,, Wright & Stevens. C, 1882.
12. Vacuum Flushing Cistern for Water Closets with Seat Action Arrangement. *Doulton & Co.* C, 1884.
13. Shanks's Reliable Water Waste Preventer. R. Cuerden. C, 1887.
14. ,, ,, ,, ,, J. Vause & Son. C, 1887.

Section 4. Flushing and Watering.

1. Combined Flush Tank and Grease Interceptor. *Adams & Co.* C, 1886.
2. Improved Siphon Flush Tank. *Doulton & Co.* C, 1887.

Section 5. Sinks.

1. "Artisans' Dwelling Sink." *G. Jennings.* C, 1879.
2. Butler's Sink, lined with Block Tin. W. Baird. C, 1884.
3. Cheap Glazed Stoneware Sinks. *Doulton & Co.* C, 1884.
4. Cup Grating for Sinks. *Thomasson & Key.* C, 1882.
5. Enamelled Fireclay Sinks. *J. & M. Craig.* **M, 1884.**
6. Fireclay Sanitary Sinks and Water Troughs. *Willcock & Co.* C, 1879.
7. Hospital Slop Sink with Waste-not Regulator Valve. *J. Tylor & Sons.* C, 1882.
8. "Imperial" Slop Sink. *J. Cliff & Sons.* C, 1886.
9. Swivel, Lock Plug, and Overflow for Sinks. *Stidder & Co.* C, 1879.

10. White Enamelled Sinks. *J. Cliff & Sons.* C, 1886.
11. „ „ *Wortley Fireclay Co.* C. 1886.
12. „ „ Fireclay Sinks. W. Baird. C, 1884.
13. „ „ „ *Bourtreehill Coal Co.* C, 1884; C, 1885.
14. White Enamelled Fireclay Sinks. *J. & M. Craig.* C, 1882; C, 1883.
15. White Enamelled Fireclay Sinks. Maguire & Son. C, 1884.
16. Enamelled Iron Slop Sink, with Regulator Supply Valve. *J. Tylor & Sons.* C, 1880.
17. Slop Sinks. *T. Twyford.* C, 1884.
18. Craig's White Enamelled Sinks. J. Vause & Son. C, 1887.

Section 6. Baths and Lavatories.

1. Bath, with Shower Douche and Spray Fittings Combined. W. Baird. C, 1884.
2. Cast-Iron Bath. *Shanks & Co.* C, 1883; C, 1884.
3. Concrete Bath in one piece. *W. H. Lascelles.* **M, 1879; C*, 1880.**
4. Enamelled Fireclay Bath. Rimington Bros. & Co. C, 1882.
5. "Eureka" Spray and Plunge Bath. *Shanks & Co.* C, 1883.
6. Shanks's "Eureka" Spray and Plunge Bath. Fergusson & Starkey. C, 1885.
7. Fireclay Enamelled Bath. *John Hall & Co.* **M, 1883.**
8. Hot-air Bath. *T. Galbraith.* **M, 1877.**
9. Porcelain Bath. *Joseph Cliff & Sons.* **M, 1883; C*, 1886.**
10. „ Baths, moulded and glazed in one piece. *Ruffard & Co.* C, 1878.
11. Well and Dry-Platform Sponge Bath. Groom & Co. C, 1885.
12. Combination Bath Fittings. *Burn & Baillie.* C, 1886.
13. Horizontal Pull Fittings for Baths and Lavatories. W. Baird. C, 1884.
14. Locking Apparatus for Bath Fittings. *Doulton & Co.* C, 1884.
15. Lavatory. Gillow & Co. C, 1878.
16. „ Basin with Flushing Rim. *C. T. Maling.* C, 1882.
17. „ Basins. *T. Twyford.* C, 1884.
18. Tip-up Lavatory Basin. *Doulton & Co.* C, 1882.
19. Clark's Anti-splash Tip-up Lavatory Basin. *J. Fell & Co.* C, 1882.
20. Flushing Rim Lavatory Basin. *J. Tylor & Sons.* **M, 1880.**
21. „ „ „ with Quick Waste. *J. Tylor & Sons.* C, 1882.
22. "Unbreakable" Fireclay Lavatory Basins for Schools, &c. Fergusson & Starkey. C, 1885.
23. Porcelain Lavatories, with movable caps for access to fittings. *Shanks & Co.* C, 1883; C, 1884.
24. "Shanks's" Porcelain Lavatory Fittings. Fergusson & Starkey. C, 1885.

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS II.—SECTION 6.—*Continued.*

25. Lavatory, with Shampooing Apparatus. W. Baird. C, 1884.
26. Jennings's Universal Shampooing Apparatus. Dinning & Cooke, C, 1882.
27. "Universal" Shampooing Apparatus. *G. Jennings.* C, 1879.
28. Shower and Douche Bracket. *Hayward, Tyler & Co.* C, 1882.
29. Morrison's Spray Lavatory. R. Cuerden. C, 1887.
30. Shanks's Imperial Lavatory. R. Cuerden. C, 1887.
31. ,, ,, ,, J. Vause & Son. C, 1887.
32. Ruffard's Enamelled Fireclay Bath. J. Vause & Son. C, 1887.

Section 7. Water Closets.

1. Artisan Closet. *Beard, Dent & Hellyer* C, 1879.
2. "Beaufort" Flush-down Closet. Humpherson & Co. C, 1885.
3. "Clear Way" Regulator Valve Water Closet, with overflow communicating with Valve Box. *J. Tylor & Sons.* C, 1880. out
4. "Crown" Cottage Water Closet. Henry Watson & Son. C, 1882.
5. Economical Combination Closet, in two pieces. *Doulton & Co.* C, 1885.
6. Economical Flush-out Closet. *Doulton & Co.* C, 1880; C, 1882.
7. "Excelsior" Water Closet. *D. T. Bostel.* **M, 1877; C*, 1878.**
8. Fowler's Water Closet. W. Harriman & Co. C, 1882.
9. Full-flush Valveless Closet. *Hayward, Tyler & Co.* **M, 1882.**
10. "Household" Water Closet. O. D. Ward. **M, 1882.**
11. ,, ,, ,, H. Trott. **C*, 1885.**
12. "Lambeth" Combination Water Closet. *Doulton & Co.* C, 1884.
13. ,, Flush-out Closet. *Doulton & Co.* C, 1883.
14. ,, Trough Closet, with Automatic Flush Tank. *Doulton & Co.* C, 1883.
15. "National" Water Closet. Henry Watson & Son. C, 1882.
16. ,, ,, ,, W. B. Morrison. C, 1883.
17. Wilcock's Automatic Flushing Closet. Maguire & Son. C, 1884.
18. Improved Seat for Water Closets. *E. & A. E. Gilbert.* C, 1883.
19. Terry's Pedal Action for Water Closets. *J. Tylor & Sons.* C, 1882.
20. Improved Shape of Trough for Water Closets. *Adams & Co.* C, 1885.
21. Shanks's Tubal Wash-out Closet. R. Cuerden. C, 1887.
22. ,, ,, ,, ,, J. Vause & Son. C, 1887.
23. ,, Wash-out Closet and Cistern combined, for Country use. J. Vause & Son. C, 1887.

Section 8. Urinals.

1. Flush-out Urinal Basin. *J. Tylor & Sons.* C, 1882.
2. White Enamelled Urinal Floor Channel. *J. Cliff & Sons.* C, 1886.

3. Shanks's Urinal with Tilting Flusher. J. Vause & Son. C, 1887.
4. Nicholls's Soot and Salt Urinal. W. P. White & Co. C, 1887.

Section 9. Sewers, Drain Pipes, and Accessories.

1. Artificial Stone Tubes. *Patent Victoria Stone Co.* C, 1879.
2. Rock Concrete Tubes. *Sharp, Jones & Co.* C, 1879.
3. Acme Sewer Pipes. *H. Percy Boulnois.* **M, 1883.**
4. Cast-iron Drain Pipes, coated with Angus Smith's Preparation. Maguire & Son. C, 1884.
5. Improved Drain Pipe, with Access Cover. *W. P. Buchan.* C, 1882.
6. Large Fireclay Drain Pipes. *Straker & Love.* C, 1882.
7. London-made Stoneware Pipes. *Doulton & Co.* C, 1884.
8. Salt-glazed Fireclay Sewer Pipes, Exhibit of. *J. Binnie.* C, 1883.
9. Stoneware Pipes. *Branksea Island Pottery Co. (Limited).* C, 1880.
10. Stoneware Drain Pipes. *Bourtreehill Coal Co.* C, 1884.
11. Hassall's Joints for Stoneware Pipes. *T. Wragg & Sons.* **M, 1886.**
12. Joint for Drain Pipes. *Doulton & Co.* C, 1882.
13. Maguire's Cradle Joint for Drain Pipes. *J. & M. Craig.* C, 1882.
14. Mawbey's Joint for Stoneware Pipes. *T. Wragg & Sons.* C, 1885; C, 1886.
15. Self-Adjusting Joint for Stoneware Pipes. *Doulton & Co.* **M, 1886; C*, 1887.**
16. Stanford's Joints for Stoneware Pipes. *Doulton & Co.* **M, 1878; C*, 1880.**
17. Stoneware Pipes for Stanford's Joint. J. Stewart, Sen. **C*, 1883.**
18. Galvanized Cast-iron Air-tight Inspection Chamber and Drain Pipes. *Burn & Baillie.* C, 1886.
19. Woodman's Stoneware Screw Plug and Collar, for access to drains. *Bailey & Co.* C, 1886.
20. Latham's Flap Valve. *Doulton & Co.* C, 1882.
21. Gordon's Junction Blocks, for Lampholes and Inlets to Sewers. *T. Wragg & Sons.* C, 1885.
22. Enamelled-Ware Open Channels for Manholes. *Doulton & Co.* C, 1884.
23. White Enamelled Straight and Curved Channels for Inspection Chambers to Drains. Broad & Co. C, 1885.
24. White Enamelled Straight and Curved Channels, and Channel Junctions for Inspection Chambers to Drains. *Wortley Fireclay Co.* C, 1885.

M, Medal; **C***, Special Certificate; C. Certificate.

CLASS II.—SECTION 9.—*Continued.*

25. Cast-iron Channels for Stable Drainage. Dinning & Cooke. C, 1882.
26. Manhole for Drains, with connections complete. *Doulton & Co.* C, 1884.
27. Bronte's Air-tight Cast-iron Manhole Cover. W. Phillips & Son. C, 1886.
28. Gordon's Ventilating Manhole Covers for Sewers with Annular Dirt Box. Wright Bros. C, 1885.
29. Air-tight Manhole Cover. *A. T. Angell.* C, 1882; C, 1883.
30. Stoneware Safety Pipes, in long lengths. *Doulton & Co.* C, 1887.
31. Cast-iron Smooth Bore Drain Pipes and Fittings. J. Vause & Son. C, 1887.

Section 10. Traps and Gullies.

1. Disconnecting Drain Trap. *W. P. Buchan.* C, 1882; C, 1883.
2. Buchan's Disconnecting Trap. *J. & M. Craig.* C, 1880; C, 1884.
3. Buchan's Drain Traps and Drain Pipes, with Access Cover. *J. & M. Craig.* C, 1882.
4. Dean's External Drain Traps, with moveable receptacle. *J. C. Edwards.* C, 1879.
5. Dean's Gully Trap. Rimington Bros. & Co. C, 1882.
6. "Eagle" Sanitary Trap, for superseding Bell Traps. Hygienic Stove & Grate Co. C, 1879.
7. Edinburgh Air-Chambered Sewer Trap. *Potts & Co.* C, 1878.
8. Exhibit of Stoneware Disconnecting Traps. J. Stewart, Sen. **M, 1883.**
9. Exhibit of Stoneware Disconnecting Traps. *J. & M. Craig.* C. 1883.
10. Gordon's Disconnecting Trap. J. J. Ellis. C, 1885.
11. " " *T. Wragg & Sons.* C, 1885.
12. Pott's Edinburgh Sewer Trap. Adams & Co. C. 1885.
13. Smith's Cast Lead Siphon Traps. J. Fell & Co. C, 1882.
14. Weaver's Ventilating Sewer Air Trap. *James Stiff & Sons.* C, 1878; C, 1885.
15. Grease Trap for Kitchen Sinks. *W. P. Buchan.* C, 1883.
16. Gordon's Iron Ventilating Cover for Disconnecting Trap. Wright Bros. C, 1885.
17. Disconnecting Gully, with back and side Entrances, and iron grating. *Doulton & Co.* C, 1879.
18. Morris's Cast-Iron Gully, with moveable Dip Pipe. Foster & Pearson. C, 1885.

19. Reversible Inlet Gully, with Dished Stoneware Cover and iron grating. *Doulton & Co.* C, 1882.
20. Simplex Reversible Gully. *J. Cliff & Sons.* C, 1886.
21. Simpson's Street Gully. *Wortley Fireclay Co.* C, 1886.
22. White Enamelled Fireclay Gullies. Broad & Co. C, 1885.
23. Ventilating Drain Siphon. *Beard, Dent & Hellyer.* C, 1879.
24. Disconnecting Chamber for House Drains, with open Stoneware Channels. J. Stewart, Sen. C, 1883.
25. Hornibrook's Catchment Grating for Steep Gradients. Hammond & Hussey. C, 1879.

Section 11. Dry Closets.

1. Dry Earth Closet. *J. Parker.* **M, 1877.**
2. ,, Closets. *British Sanitary Co.* **M, 1882; C*, 1883; C*, 1884.**
3. Dry Earth Closet, without Separator. *R. R. Heap.* **M, 1883; C*, 1884; C*, 1887.**
4. Dry Earth Commode, without Separator. *J. Parker.* C, 1880.
5. Dry Closet, suitable for Ashes or Disinfecting Powder. *Lewis Moser.* **M, 1880.**
6. Moser's Self-Acting Dry Closet. J. C. Onions (Limited.) C, 1879.
7. Moule's Earth Closets. *Moule's Patent Earth Closet Co.* **M, 1878; C*, 1879; C*, 1885; C*, 1886.**
8. Moule's Earth Closets. Wippell Bros. & Row. **C*, 1880.**
9. Nicholl's Soot and Salt Closet. W. P. White & Co. **M, 1886; C*, 1887.**
10. Self-Acting Earth Closet. *British Sanitary Co.* C, 1880.
11. Excreta Pail (oak), with Spring Lid. *B. B. Haresceugh & Co.* **M, 1877; C*, 1878.**
12. Portable Cinder Sifting Ash Closet, with Soil Pail. *Morrell's Sanitary Co.* **M, 1878; C*, 1879; C*, 1885; C*, 1886; C*, 1887.**
13. Air-tight Soil Pail, with Slide Catch. Parkinson, Sweaney & Co. C, 1887.

Section 12. Sewage Treatment.

1. Iron Basket Sewage Strainer. *T. Harnett Harrisson.* C, 1883.
2. Pneumatic Liquid Ejector. *Isaac Shone.* C, 1878.

Section 13. Miscellaneous Sanitary Goods.

1. "Eclipse" Apparatus for Testing Drain and other Pipes. *Burn & Baillie.* C, 1886.
2. India Rubber Expanding Plug for Drain Testing. *Burn & Baillie.* C, 1886.

M, Medal; **C***, Special Certificate; **C**, Certificate.

CLASS II.—SECTION 13.—*Continued.*

3. Watt's Asphyxiator for Testing Drains with Smoke. Baird, Thompson & Co. C, 1884.
4. Drain-cleaning Rods. and Stoneware Horse Manger. *Oates & Green.* C, 1878.
5. Brian Jones's Joint for connecting Water Closet with Soil-pipe. Capper, Son & Co. C, 1882.
6. Improved method of connecting Lead Pipes with Stoneware Pipes. *T. Harnett Harrisson.* C, 1883.
7. India Rubber Connection for joining Flushing Pipe to Water Closet Basin. *T. Twyford.* C, 1884.
8. Joint for Lead Pipes. *J. Tylor & Sons.* C, 1882.
9. Clip Pipe Joint. *Humpherson & Co.* C, 1885.
10. Cold Metal Double Cone Mechanical Lead Pipe Joints. *Elliott, Edminson & Olney.* C, 1885.
11. "Siphozella" Pipe Fastening. *G. W. Potter.* C, 1886.
12. Roberts's Sand Distributor for 2-horse Tram-track. *Sanitary & Highway Appliance Co.* **M, 1885.**
13. Sand Distributor for Roads. *R. Willacy.* **M, 1885.**
14. Sanitary Appliances, Exhibit of. W. P. Buchan. **M, 1883.**
15. " " Maguire & Son. **M, 1884.**
16. " Earthenware. *C. T. Maling.* C, 1882.
17. Roberts's Street Orderly Bin. *Sanitary & Highway Appliance Co.* **M, 1885.**
18. Galvanized Iron Dust-Bin. W. F. Johnson. C, 1885.
19. Night Soil Receptacle, with Spring Lid. *E. G. Kirk.* C, 1885.
20. Nicholls's Hospital Pail. W. P. White & Co. C, 1886.
21. Roberts's Asphalte Cauldron. *Sanitary and Highway Appliance Co.* C, 1885.
22. Working Model of Cattle Drinking Trough. *R. Pringle, M.D.* C, 1885.
23. Laws' Pathway Rubbish Receiver. Parkinson, Sweaney & Co. C, 1887.

CLASS III.—HEATING, LIGHTING AND VENTILATING.

Section 1. Heating Apparatus.

1. Fibre Asbestos Open Gas Fire. *H. & C. Davis & Co.* **Medal offered by the Exeter Gas Co., 1885; C*, 1886.**
2. Fibre Asbestos Open Gas Fire. *The General Gas Heating & Lighting Co.* **Medal offered by the Gas Department of the Corporation of Leicester, 1885; M, 1885.**
3. Lump Asbestos Open Gas Fire. *J. Wright & Co.* **M, 1885.**
4. " " " *Arden, Hill & Co.* C, 1885.

5. Dr. Bond's Euthermic Ventilating Gas Stove. *Sanitary & Economic Supply Association.* **Medal offered by the Exeter Gas Co., 1880; M, 1880.**
6. Ventilating Open Gas Fire. *J. Wright & Co.* C, 1884.
7. Radiating Gas Fire. *Chas. Wilson & Sons.* C, 1886.
8. Marsh Greenall's Regenerating Gas Heating Stove. *J. Greenall.* C, 1886.
9. "Cosey" Portable Open Gas Fire, with Platinum Wire and Asbestos Packing. *John Wright & Co.* C, 1882.
10. Laundry Stove and Copper Boiler. Maguire & Son. C, 1884.
11. Slow Combustion Stoves. *Musgrave & Co.* **M, 1884.**
12. Tortoise Laundry Stove. *Hydes & Wigfull.* C, 1883.
13. ,, Slow Combustion Stoves. *Hydes & Wigfull.* C, 1883.
14. ,, ,, ,, ,, W. Carson & Sons. C, 1884.
15. Ventilating Tile Stove. *Doulton & Co.* **M, 1880; C*, 1882; C*, 1883; C*, 1884; C*, 1885.**
16. Glazed Ware Mantelpiece, with Slow Combustion Grate. *Doulton & Co.* C, 1884.
17. Grates, Mantelpieces, and Over-mantels. Dinning & Cooke. C, 1882.
18. Thermhydric Ventilating Hot-water Open Fire Grate. *H. Saxon Snell.* C, 1878.
19. George's Calorigen. Dinning & Cooke. C, 1882.
20. Horizontal Spiral Lavatory Heater. *Thomas Fletcher.* **M, 1885.**
21. Challenge Hot Water Boiler. *J. Keith.* **M, 1883.**
22. Steam Heating Apparatus, combining heating and ventilating. Mather & Armstrong. C, 1882.
23. Warming and Ventilating Appliances. *G. E. Pritchett.* C, 1878.
24. Corrugated Iron Hot Water Warming Appliances. *G. E. Pritchett.* C, 1880.
25. Heating Apparatus for Small Greenhouses. T. Sharman. C, 1885.
26. Tubular Calorifer for Greenhouses. *Will. Thornburn.* C, 1882.
27. Conservatory Boiler, with Hot Water Pipe. Wippell Bros. & Row. C, 1880.
28. Steam Kettle, with specially arranged Tap for drawing Boiling Water. Frank Ashwell. C, 1885.
29. Silicate Cotton Composition for Covering Steam Pipes. C. Cadle. C, 1884.
30. Open Gas Fire. *Chas. Wilson & Sons.* C, 1887.
31. Gas Kettle. *Chas. Wilson & Sons.* C, 1887.

Section 2. Cooking Apparatus.

1. Large Gas Cooking Stove with Boiler. *Thos. Fletcher.* **Medal offered by the Gas Department of the Corporation of Leicester, 1885; M, 1885.**

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS III.—SECTION 2.—*Continued.*

2. Large Gas Cooking Stove with Boiler. *General Gas Heating & Lighting Co.* **Medal offered by the Exeter Gas Co., 1885; M, 1885.**
3. Large Gas Cooking Stove with Boiler. *J. Wright & Co.* C, 1885.
4. Large Gas Cooking Stove. *Wright & Co.* C, 1886.
5. "Eureka" Gas Cooking Stove. *J. Wright & Co.* **Medal offered by the Exeter Gas Co., 1884; M, 1884.**
6. "Eureka" Artisan Gas Cooking Stove. *J. Wright & Co.* **Medal offered by the Gas Department of the Corporation of Leicester, 1885; M, 1885.**
7. Artisan Gas Cooking Stove. *H. & C. Davis & Co.* **M, 1885.**
8. ,, ,, ,, *General Gas Heating & Lighting Co.* C, 1885.
9. Enamelled "Metropolitan" Gas Cooker. *H. & C. Davis & Co.* **M, 1886.**
10. Apparatus for Cooking by Gas. *Billing & Co.* **M, 1878; C*, 1879.**
11. Apparatus for Cooking by Gas. *S. Leoni & Co.* **M, 1878.**
12. Combined Close Fire and Gas Cooking Range. *Carron Co.* C, 1883.
13. Gas Cooking Stove, lined with White Tiles. *Arden, Hill & Co.* C, 1884.
14. Solid Flame Boiling Stove. *Arden, Hill & Co.* C, 1882.
15. "Sunlight Stove." Chorlton & Dugdale. C, 1880.
16. Cooking Stove, with Warm Air Chamber. Thomas Waller. C, 1879.
17. Artisan Cooking Range. *Walker, Turnbull & Co.* **M, 1883.**
18. Cooking Range, with Revolving Fire for the Prevention of Smoke. *Whyte & Bradford.* **M, 1883.**
19. Cottage Range. Wippell Bros. & Row. C, 1880.
20. Crabtree's Kitchen Range. *E. & J. M. Verity.* **M, 1885.**
21. ,, ,, ,, E. Foulds. **C*, 1886.**
22. Devonshire Cooking Range. *T. J. Constantine.* C, 1880.
23. Dow's Close and Open Fire Cooking Range. W. McGeoch & Co. C, 1883.
24. Economical Cooking Range. G. H. Harris. **M, 1877; C*, 1878.**
25. Improved Open or Close Range Kitchener. W. P. Wenham. **M, 1879.**
26. Improved Wilson Cooking Range. *Wilson Engineering Co.* **M, 1882; C*, 1883; C*, 1884.**
27. Phœnix Portable Range, and the Birmingham Range with Reducible Fire without Gas. Hassall & Singleton. **M, 1878.**
28. Simplex Cooking Range. *Walker, Turnbull & Co.* C, 1883.
29. "Sine quâ non" Open and Close Fire Range. *A. Shaw & Son.* **M, 1883.**

30. Wilson Portable Close Cooking Range. *Wilson Engineering Co.* **M, 1880.**
31. New Cooker and Steamer. *F. & C. Hancock.* C, 1886; C, 1887.
32. Tin Cooking Utensils. *Mrs. A. Lewis.* C, 1879.
33. National Kitchen Range. Elliott, Edminson, & Onley. C, 1887.

Section 3. Smoke Preventing Appliances.

1. Mechanical Stoker. *G. Sinclair.* **M, 1883.**
2. Open Grate for Consuming Smoke. *James Smith.* C, 1882.
3. Smoke Preventing Mechanical Stoker and Camel Furnace. *E. Bennis.* **M, 1887.**
4. Mechanical Smoke Preventing Stoker and Furnace. *T. & T. Vicars.* **M, 1887.**

Section 4. Lighting, including Electric Lighting.

1. Portable Gas Apparatus for Manufacturing Gas from Gasoline. *F. W. Clarke's Portable Gas Apparatus Co. (Limited).* C, 1879.
2. Albo-Carbon Light. Will. Forrest. C. 1882.
3. " " " Osbert Henderson. C, 1883.
4. Duplex Burner. *T. Heron.* C, 1882.
5. Improved Gas Burners. *Bray & Co.* C, 1879.
6. Siemens' Regenerative Gas Burner. Mather & Armstrong. **Richardson Medal, 1882; M, 1882.**
7. "Rheo-meter" Street Lamp Regulator. *S. Leoni & Co.* C, 1878.
8. Mercury Gas Governor. *James Stott & Co.* **M, 1882; C*, 1885.**
9. "Stott" Gas Governor. A. Brown & Co. **C*, 1883.**
10. Stott's Mercury Gas Governor. John L. Smallman. **C*, 1884.**
11. Gaseliers and Gas Brackets. Willey & Co. C, 1880.
12. "Milwaukee" Glass Lantern or Hurricane Lantern. S. E. Ransome & Co. C, 1879.
13. Miner's Safety Lamp. *W. Purdy.* **M, 1885.**
14. Hinks's Duplex Lamp with Extinguisher. Mather & Armstrong. C, 1882.
15. Incandescent Electric Lamp. *Woodhouse & Rawson.* **M, 1885; C*, 1886.**
16. Swan's Incandescent Electric Lamps. J. Edmundson & Co. **Richardson Medal, 1884; M, 1884.**
17. Cunningham Woodhouse & Rawson Magnetic Cut-Out for Electric Lighting. *Woodhouse & Rawson.* C, 1885; **M, 1886.**
18. Combination Plug and Meter Bridge (Davis & Moynhan's Patent) *Woodhouse & Rawson Electric Supply Co. of Great Britain.* C, 1886.

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS III.—SECTION 4.—*Continued.*

19. Chappuis's Daylight Reflector. Wippell Bros. & Row. C, 1880
20. Prismoidal Pavement and Floor Lights. *Hamilton & Co.* **M, 1879.**
21. Portable Electric Glow Lamp. Maritime and General Improvement Co. C, 1887.
22. Welsbach's Incandescent Gas Burner. Elliott, Edminson & Olney. **M, 1887.**
23. "Eclipse" Gas Governor. *Hargreaves & Bardsley.* C, 1887.
24. Combined Gas Governor and Cut-off Valve. *James Stott & Co,* C, 1887.

Section 5. Ventilating Gas Burners.

1. Wenham's Ventilating Gas Lamp. *Wenham's Patent Gas Lamp Co.* **M, 1884.**

Section 6. Ventilators.

1. Blackman Air Propeller. *F. Ashwell.* **M, 1885.**
2. Air Inlet Head for Drain Ventilation. *H. S. Cregeen.* C, 1882.
3. Auto-Pneumatic Ventilation. Nathan Hunt. **M, 1880.**
4. Boyle's Mica-Valved Outlet Ventilator. W. P. Wenham. C, 1879.
5. Conical Ventilators. *J. E. Ellison.* **M, 1878; C*, 1879; C*, 1883; C*, 1884; C*, 1885.**
6. Double Current Ventilators. *Hill & Hey.* C, 1883.
7. Glass Louvre Ventilators. *J. Moore.* **M, 1880.**
8. Glass Revolving and Sliding Ventilators. *H. W. Cooper & Co.* C, 1883.
9. "Imperial" Ventilating Window. U. Knell. C, 1879.
10. Method of Costless Ventilation. *Peter Hinckes Bird.* C, 1879.
11. Chimney Breast Outlet Ventilator. *C. Kite & Co.* C, 1883; C, 1884.
12. Ornamental Inlet Ventilators. C. H. Sharp & Co. C, 1880.
13. Outlet Ventilator. *C. Kite & Co.* C, 1882.
14. "Radiator" Ventilator, with Screw Action. *J. E. Ellison.* C, 1883; C, 1884.
15. Telescoped Wall Inlet Ventilator. *C. Kite & Co.* C, 1885.
16. Wall Inlet Ventilator. *C. Kite & Co.* C, 1883; C, 1884.
17. Ventilating and Warming Appliances. *G. E. Pritchett.* C, 1878.
18. Ransome's Artificial Stone Air Brick. Wippell Bros. & Row. C, 1880.
19. Morgan's Stench Trap. Nailsworth Foundry Co. C, 1882.
20. Humidifier and Air Inlet. *Control Air Propeller Co.* C, 1887.
21. Blackman Air Propeller. J. & W. Kirkham. **C*, 1887.**

CLASS IV.—PERSONAL HYGIENE, FOODS, FILTERS AND DISINFECTANTS.

Section 1. Clothing.

1. "Arachne" Flannel. *E. Ward & Co.* C, 1886.
2. Crocodile Hide Leather. *Borough Leather Warehouse Co.* C, 1883.
3. Furs, Exhibit of. Brooke Tyrrell. C, 1884.
4. Camels' Hair Clothing & Bedding. *Dr. Jæger's Sanitary Woollen System Co.* C, 1886.
5. Exhibit of Sanitary Clothing. *E. Ward & Co.* **M, 1886.**
6. Innocuously-dyed Woollen Goods. *Donegal Industrial Fund.* **M, 1884.**
7. Sanitary Clothing. *Dr. Jæger's Sanitary Woollen System Co.* **M, 1886.**
8. Ventilatorium Waterproof Garments. *Bartrum, Harvey & Co.* C, 1878.
9. Hygeia Corset. *E. Ward & Co.* C, 1886.
10. Ventilating Corsets. *E. & C. Dillon.* C, 1886.
11. Pith Helmet. J. Morgan. C, 1884.
12. Ventilated Hats. *W. Graham.* C, 1884.
13. Boot and Shoe Uppers. Staynes & Sons. C, 1885.
14. Improved shape of Boot. *J. Hotblack & Son.* C, 1884.
15. "Natural" Boot for Ladies. *A. Webb.* C, 1884.
16. Rhinocerous Hide "S" Boot. *Patrick Short.* C, 1884.
17. Dr. Jaeger's Sanitary Clothing. Constantine Bros. **C*, 1887**
18. "Souple" Boots. *W. Barlow.* C, 1887.
19. Kershaw's Cellular Cotton Fabric. *Lewis Haslam.* **M, 1887.**
20. All-Wool Flannels (undyed). *Humphreys & Thomas.* C, 1887.
21. Woollen Fabrics. *W. Rothwell.* C. 1887.

Section 2. Beds and other Furniture.

1. Central Tube Water Mattress. Brady & Martin. C, 1882.
2. Institution Bed, with Woven-Wire Mattress. Pearson & Co. C, 1884.
3. Pitch Pine Lath Mattress. *Chorlton & Dugdale.* C, 1884.
4. Portable Bed, with Liverpool Spring Mattress. *Billington Bros.* C, 1884.

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS IV.—SECTION 2.—*Continued.*

5. Spring Mattress. Bussey & Co. C, 1879.
6. ,, ,, A. Gardner & Son. C, 1883.
7. ,, Mattresses. *Billington Bros.* C, 1883.
8. "Swing" Woven Wire Mattress. *Chorlton & Dugdale.* **M, 1884.**
9. Excelsior Spring Mattress. *Chorlton & Dugdale.* **M, 1877; C*, 1878; C*, 1879; C*, 1880; C*, 1882; C*, 1883; C*, 1884.**
10. Wood's Double Woven Galvanized Steel Wire Spring Mattress. *Longford Wire, Iron and Steel Co.* C, 1886.
11. "Universal" Invalid Tubular Water and Air Bed. *Pocock Bros.* **M, 1878; C*, 1879.**
12. Combination Bedstead. W. Fleming. C, 1884.
13. "Excelsior" Ships' Berth. *Chorlton & Dugdale.* C, 1883.
14. Hinged Cot. Pim Bros., Limited. C, 1884.
15. Bed Rest, with movable Arms. William Brock & Co. C, 1880.
16. "Grasshopper" Couch for Invalids. *William Hamilton.* C, 1878; C, 1882.
17. Automaton Seat for Drapers. *Colman & Glendenning.* C, 1880.
18. "Nonsuch" Adjustable Chair. William Brock & Co. C, 1880.
19. Furniture, Exhibit of. *Pim Bros., Limited,* **M, 1884.**
20. ,, ,, *F. R. Scott & Co.* C, 1884.
21. Fernby's "Paragon" Camp Furniture. Wippell Bros. & Row. C, 1880.
22. Chorlton's Invalid Iron Bedstead, with Wire Mattress. Taylor's Cabinet Making and Upholstery Warehouse. **M, 1887.**

Section 3. Hospital and Sick-room Appliances.

1. Hospital and Sick-room Appliances, Exhibit of. *W. B. Hilliard & Sons.* **M, 1883.**
2. Invalid Furniture. *J. Carter.* **M, 1880.**
3. Folding Invalid Bed. *Ancell Ball.* C, 1879.
4. Hospital Bed, fitted with Raising Appliances. *Chorlton & Dugdale.* C, 1884.
5. Hospital Bed, with new Spring Mattress. *Chorlton & Dugdale.* C, 1884.
6. "Invalid's" Adjustable Bed. *Chorlton & Dugdale.* C, 1880.
7. Metallic Tubular Bedsteads and Invalid Bed Rests. *Thomas Allen.* C, 1878.
8. Self-acting Sick Bed. E. K. Groves. C, 1883.
9. Ambulance Wheeled Litter. *Major F. Duncan.* **M, 1878.**
10. Burn and Wound Boxes. *W. B. Hilliard & Sons.* C, 1883.
11. India Rubber Vessels for Hospital use. *H. A. Murton.* C, 1882.
12. Isolating Curtain. *W. B. Hilliard & Sons.* C, 1883.

13. China Cups and other Vessels for Invalid use. *Townsend & Co.* C, 1882.
14. Absorbent Cotton and Antiseptic Sponges. Burroughs, Wellcome & Co. C, 1884.
15. Stypium Absorbent Antiseptic Surgical Dressings. Stephenson & Travis. C, 1884.

Section 4. Domestic Appliances.

1. Exhibit of Machines for Domestic use. *F. & C. Hancock.* **M, 1883; C*, 1885; C*, 1886.**
2. Ornamental Domestic Appliances. W. F. Johnson. **M, 1885.**
3. Various Inventions for Promoting Domestic Economy. W. H. Hilton. C, 1878.
4. Black Diamond Boot and Shoe Cleaning Machine. *T. Bradford & Co.* C, 1885.
5. Bower's Potato Steamer. Groom & Co. C, 1884.
6. Fishburn's Scarborough Freezer. *King & Co.* C, 1886.
7. ,, Tubular Refrigerators. *King & Co.* C, 1886.
8. Housemaid's Box, with Sifter. Wippell Bros. & Row. C, 1880.
9. Dough Kneading Machine. *F. & C. Hancock.* C, 1880.
10. Machine for Washing and Peeling Potatoes. *F. & C. Hancock.* C, 1882.
11. Self-indicating Tea or Coffee Infuser. Groom & Co. C, 1884.
12. Automatic Chariot for Children. Will. Bowden. C, 1882.
13. Compostella Fire Lights for Lighting Fires. *Compostella Fire Light Co.* C, 1878.
14. India Rubber Gas Tubing. *A. Hutchinson & Co.* C, 1880.
15. "Noiseless Ware." Vernon's Patent China & Glass Co. C, 1883.
16. Pendulous Food Warmers. Osbert Henderson. C, 1883.
17. Porpoise Oil Dubbin. *J. T. Dales.* C, 1885.
18. "Unique" Folding Box. *T. P. Bethell.* C, 1885.
19. Wicker-work and Brushes. *Wilberforce School for the Blind.* **M, 1886.**
20. Electric Bells, Exhibit of. *J. T. Gent & Co.* C, 1885.
21. Electro-Magnetic Telephones. The Stanhope Co. Limited. C, 1886.
22. Butter Squeezing Machine. Aylesbury Dairy Co. C, 1886.
23. Dairy Appliances, Exhibit of. *Vipan & Headly.* **M, 1885.**
24. ,, ,, Aylesbury Dairy Co. **M, 1886.**
25. Danish Cream Separator. Vipan & Headly. C, 1885.
26. Heavy Steel Railway Churn, with Malleable Top and Dust-proof Lid. *Vipan & Headly.* C, 1885.
27. Machine for Washing and Cooling Butter. *F. & C. Hancock.* **M, 1877; C*, 1878.**
28. New Propeller Churn. *F. & C. Hancock.* C, 1880.
29. Stoneware Churns. *F. Grosvenor.* C, 1883.
30. Cinder Sifting Dust Bin. *Morrell's Sanitary Company.* C, 1887

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS IV.—*Continued.*

Section 5. School Fittings.

1. Dual Desk, with separate Gangway Seat. *Thos. Larmouth & Co.* C, 1878.
2. "Reliance" Lift-up Desk. Midland Educational Co. C, 1885.
3. School Desks with Shifting Seats. *Colman & Glendenning.* C, 1878.
4. School Furniture. *Colman & Glendenning.* **M, 1880.**
5. "Simplex" Desk, with Adjustable Foot Board. *Taylor & Co.* C, 1885.
6. Westminster Single Desk, with Sliding Top and Convex Support to the Seat. *North of England School Furnishing Co.* C, 1886.

Section 6. Gymnastic Apparatus.

1. Bicycles and Tricycles, Exhibit of. *Humber & Co.* **M, 1885.**
2. " " J. Parr & Co. C, 1885.
3. Tricycles, Exhibit of. W. Carson & Sons. C, 1884.
4. " " Fletcher Bros. C, 1884.
5. Cruising Canoe. *R. J. Turk.* **M, 1885.**

Section 7. Foods.

1. Chutneys. *J. Edmunds.* C, 1886.
2. Empress Currie Powders. *J. Edmunds.* C, 1882.
3. Improved Oat Cakes. *A. & R. Scott.* C, 1886.
4. Infant Rusks and Nursery Biscuits. *J. Montgomerie.* C, 1886.
5. Midlothian Oat Flour. *A. & R. Scott.* C, 1883.
6. Miller's Pride Oatmeal. *Binns & Armitage.* C, 1885.
7. Rusks, Shortbread, and Oatcakes. *W. H. Torrance.* C, 1885; C, 1886.
8. Preserved Fruits. *C. H. Senn.* C, 1886.
9. Coloured Confectionery. *M. A. Craven & Son.* **M, 1886.**
10. Genuine Mustard. *Irvine & Co.* C, 1882; C, 1883.
11. Pickles and Sauces. *Beveridge & Co.* C, 1883.
12. Chocolate Paste. *A. J. M. Bolonachi.* C, 1886.
13. Cocoa Extract and Preparations of Chocolate. *J. S. Fry & Sons.* C, 1880.
14. Indian Tea. Indian Tea Co. C, 1883.
15. Optimus Coffee Extract. *E. Clarke & Co.* C, 1884; C, 1885; C, 1886.
16. Soluble Dutch Cocoa. Bensdorp & Co. C, 1884.
17. Preparations of Digestive Ferments. *Burroughs, Wellcome & Co.* C, 1886.

18. Malt Extract. *Burroughs, Wellcome & Co.* C, 1886.
19. Kepler's Extract of Malt, and Combinations of it with Pepsine, Chocolate, and Cod Liver Oil. *Burroughs, Wellcome & Co.* C, 1884.
20. Powders for Peptonising Milk. *Burroughs, Wellcome & Co.* **M, 1884.**
21. Digestive Ferments and Invalid Food Preparations. *Burroughs, Wellcome & Co.* **M, 1887.**
22. Confectionery, with Harmless Colouring Matter. *W. R. Lythgoe.* C, 1887.
23. Cadbury's Chocolate and Cocoa Essence. Isaac Cleworth. C, 1887.

Section 8. Domestic Filters.

1. Artificial Stone Filters, for Cleansing Rain Water for Domestic Use. Thorn & Co. C, 1878.
2. "Bijou" Filtre Rapide. *P. A. Maignen.* C, 1880.
3. Bischof's Spongy Iron Filter. *Spongy Iron Water Purifying Co.* **M, 1877.**
4. Carbonised Iron Stone Mound Filter for Water. J. A. Stephan. C, 1880.
5. Field Hospital Filter. *P. A. Maignen.* C, 1885.
6. Filtre Rapide. *P. A. Maignen.* **M, 1879; C*, 1880; C*, 1883; C*, 1884; C*, 1885.**
7. Improved Filtre Rapide. *P. A. Maignen.* C, 1882.
8. Silicated Carbon Double Chambered Table Filters. *Silicated Carbon Filter Co.* C, 1880.
9. Silicated Carbon Filtering Material. *Silicated Carbon Filter Co.* C, 1882.
10. Soldier's Filter. *P. A. Maignen.* C, 1885.
11. Spencer's Magnetic Filters. *The Magnetic Filter Co.* **M, 1886.**

Section 9. Mineral Waters.

1. Ginger Ale and Lemonade. *Newry Mineral Water Co. (Limited).* C, 1879.
2. Lemonade, Lime Juice, and Ginger Ale. *Gulliver & Co.* C, 1879.
3. Potash, Soda and Seltzer Waters, and Lemonade. *British & Foreign Mineral Water Co.* C, 1882.
4. Preparations of Lime Juice, Aromatic Ginger Ale, and Quinine Tonic. *Carter & Co.* C, 1880.
5. Seltzer, Soda and Potash Waters, and Orange Quinine Tonic. *G. H. Skinner.* C, 1880.
6. Seltzer Water. *Jewsbury & Brown.* C, 1878.
7. Zoedone. *Evans & Co.* C, 1879.
8. Plant for Aerating Mineral Waters. *J. Galloway.* **M, 1887.**

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS IV.—*Continued.*

Section 10. Soap and other Detergents.

1. Carbolic Soaps. *F. C. Calvert & Co.* C, 1884; C, 1885; C, 1886.
2. Hydroleine Soap Powder. *F. J. Harrison & Co.* C, 1885.
3. Jeyes's Household Disinfecting Soaps. *Jeyes's Sanitary Compounds Co.* C, 1885.
4. "Lanoline" Soap. *Burroughs, Wellcome & Co.* C, 1886.
5. Olive Oil Soap. W. Bowden. C, 1885.
6. Soaps. S. Boyd. C, 1884.
7. Tooth Soap. *F. C. Calvert & Co.* C, 1885.
8. Sanitary Rose Powder. *Jas. Woolley & Co.* C, 1886.
9. Sunlight Soap. *Lever Bros.* C, 1886.

Section 11. Antiseptics and Disinfectants.

1. Alum Cake. *Dublin & Wicklow Manure Co.* C, 1884.
2. Antiseptic Preparations, Exhibit of. *J. Richardson & Co.* **M, 1885.**
3. Boro-Phenol. *F. C. Calvert & Co.* C, 1886.
4. Calvert's Carbolic Acid for Disinfecting purposes. *Calvert & Co.* **M, 1877; C*, 1879; C*, 1880; C*, 1883; C*, 1884; C*, 1885; C*, 1886.**
5. Chemical Preparations and Apparatus. Société Française d'Hygiène. **M, 1877.**
6. Chemical Substances used for Disinfection. *Mackey, Mackey & Co.* **M, 1884.**
7. Chemical Substances used for Disinfection. S. Boyd. C, 1884.
8. Jeyes's Perfect Purifier. *Jeyes's Sanitary Compounds Co.* C, 1879; C, 1882; C, 1883; C, 1884; **M, 1885; C*, 1886.**
9. Little's Soluble Phenyle. *Morris, Little & Co.* **M, 1878.**
10. Pixene. *J. Wheeler.* C, 1883; C, 1884.
11. Preparations from Carbolic Acid. *F. C. Calvert & Co.* C, 1886.
12. 50 $^0/_0$ Carbolic Disinfecting Powder. *F. C. Calvert & Co.* C, 1883.
13. Red Cross Yellow Fluid. *Antiseptic Apparatus Manufacturing Co. (Limited).* C, 1882.
14. Sanitas Oil. *Sanitas Co. Limited.* **M, 1882.**
15. Sanitary Night Lights. *A. Wright.* C, 1885.
16. Soluble Cresol. *F. C. Calvert & Co.* C, 1884.
17. Strype's Process for Drying Blood. Dublin & Wicklow Manure Co. **M, 1884.**
18. Soluble 70 $^0/_0$ Carbolic Acid. *F. C. Calvert & Co.* C, 1887.

Section 12. Disinfecting Apparatus.

1. Acid Pump and Syphon. Chas. W. Walker. **M, 1879.**
2. Washington Lyon's Steam Disinfector. *Manlove, Alliott, Fryer & Co.* C, 1882; **C*, 1887.**
3. Dr. Scott's Disinfecting Apparatus. *Maguire & Son.* C, 1882; C, 1884.
4. Portable Disinfecting Apparatus. *Fraser Bros.* **M, 1879.**
5. Steam Disinfector. *J. W. Lyon.* **M, 1885; C*, 1886.**
6. Vaporiser for Disinfecting. *F. C. Calvert & Co.* C, 1880.

CLASS V.—MISCELLANEOUS.

Section 1. Scientific Instruments.

1. Barometrical and Thermometrical Instruments. *G. E. Pritchett.* C, 1879.
2. Improvements in Thermometrical and Barometrical Instruments. *G. E. Pritchett.* C, 1880.
3. Large Legible Spirit Thermometer. *P. Hinckes Bird.* C, 1880.
4. New Oven Pyrometer. *Joseph Davis & Co.* C, 1882.
5. Thermometrical Instruments. *G. E. Pritchett.* C, 1878.
6. Instruments used by Medical Officers of Health. Brady & Martin. C, 1882.
7. Schaible's Apparatus for the Estimation of Carbonate of Lime in Cement. Casebourne & Co. C, 1886.
8. Webster's Photometer. *Webster & Co.* C, 1879.
9. Tintometer. *J. W. Lovibond.* **M, 1887.**

Section 2. Books and Periodicals.

1. Books on Hygiène. Société Française D'Hygiène. **M, 1882.**
2. Exhibit of Drawings and Books Relating to Disposal of Sewage in Paris. A. Durand-Claye. C, 1883.
3. Publications. *Ladies' Sanitary Association.* C, 1878.
4. "Sanitary Engineer" of New York, Newspapers. *H. C. Meyer.* **M, 1883.**
5. Sanitary Publications. *Smith, Elder & Co.* C, 1882; C, 1883; C, 1884.

Section 3. Prevention of Accidents.

1. Hand Ambulance. Leicester Ambulance Corps. C, 1885.
2. "Kredemnon" Life-saving Garments. *F. Wentworth & Co.* **M, 1883,**

M, Medal; **C***, Special Certificate; C, Certificate.

CLASS V.—SECTION 3.—*Continued.*

3. Leander Life Belt. J. W. Elvery & Co. C, 1884.
4. Method of rendering Timber Non-inflammable. *A. Gardner & Son.* C, 1883.
5. Safety Belt Shippers. *Selig, Sonnenthal & Co. Limited.* C, 1879.
6. Ambulance Stretcher for Use in Mines. *J. H. Peck & Co.* C, 1887.

Section 4. Respirators and Face Guards for Unhealthy Occupations.

1. Tyndall's Smoke Respirator. J. Sinclair. **M, 1879.**
2. Loeb's Respirators. Maritime and General Improvement Co. C, 1887.

Section 5. Fire Preventing Appliances.

1. Chemical Fire Exterminator. *J. Sinclair.* C, 1879.
2. Dick's L'Extincteur. J. Hildesheim. C, 1883.
3. "Lightning" Fire Extincteur. *J. Galloway.* **M, 1887.**
4. "Reality" Hand Fire Extincteur. *J. Haslam.* **M, 1887.**

Section 6. Methods for the Disposal of the Dead.

1. "Earth to Earth" Coffins. *London Necropolis Co.* C, 1878.
2. Folding Bier and Car for Simplifying Funerals. *S. Stretton.* C, 1879.

Section 7. Sundries.

No Awards.

ALPHABETICAL LIST OF EXHIBITORS WHO HAVE RECEIVED AWARDS AT THE EXHIBITIONS.

EXPLANATORY NOTE.—The Roman figures refer to the Class; the ordinary figures to the Section; and the figures in old type to the consecutive number in that Section, *e.g.*:—

Cl. IV., Sec. 3, no. 7,—Indicates Class IV., Section 3, no. 7.

Adams & Co., *York*. Cl. II., Sec. 4, no. 1; Sec. 7, no. 20; Sec. 10, no. 12.
Adams, R., 7, *Great Dover Street, London*. Cl. I., Sec. 1, nos. 32, 33, 34, 36, 37, 38.
Allen, Thomas, *St. Augustine's Parade, Bristol*. Cl. IV., Sec. 3, no. 7.
Aluminium Crown Metal Co., *Glasgow*. Cl. I., Sec. 1, no. 1.
Angell, A, T., *London*. Cl. II., Sec. 9, no. 29.
Antiseptic Apparatus Manufacturing Co., Limited, *London*. Cl. IV., Sec. 11, no. 13.
Arden, Hill & Co., *Birmingham*. Cl. III., Sec. 1, no. 4; Sec. 2, nos. 13, 14.
Ashwell, F., *Leicester*. Cl. III., Sec. 1, no. 28; Sec. 6, no. 1.
Aveling & Porter, *Rochester*. Cl. I., Sec. 7, no. 7.
Aylesbury Dairy Co., *London*. Cl. IV., Sec. 4, nos. 22, 24.
Bailey & Co., *London*. Cl. II., Sec. 9, no. 19.
Baird, Thompson & Co., *Glasgow*. Cl. II., Sec. 13, no. 3.
Baird, W., *Dublin*. Cl. II., Sec. 1, no. 2; Sec. 5, nos. 2, 12; Sec. 6, nos. 1, 13, 25.
Ball, Ancell, *Spalding*. Cl. IV., Sec. 3, no. 3.
Barlow, W., *Bolton*. Cl. IV., Sec. 1, no. 18.
Barrett, H. J., *Hull*. Cl. I., Sec. 7, no. 9.
Bartrum, Harvey & Co., *London*. Cl. IV., Sec. 1, no. 8.
Bean, A. T., 5, *Cannon Row, London*. Cl. II., Sec. 3, no. 3.
Beard, Dent & Hellyer, 21, *Newcastle Street, London*. Cl. II., Sec. 7, no. 1; Sec. 10, no. 23.
Bennis, E., *Bolton*. Cl. III., Sec. 3, no. 3.
Bensdorp & Co., *London*. Cl. IV., Sec. 7, no. 16.
Bethell, T. P., *Liverpool*. Cl. IV., Sec. 4, no. 18.

Beveridge & Co., *Glasgow*. Cl. IV., Sec. 7, no. 11.
Billing & Co., *Hatton Garden, London*. Cl. III., Sec. 2, no. 10.
Billington Bros., *Liverpool*. Cl. IV., Sec. 2, nos. 4, 7.
Binnie, J., *Gartcosh, Glasgow*. Cl. II., Sec. 9, no. 8.
Binns & Armitage, *Derby*. Cl. IV., Sec. 7, no. 6.
Bird, Peter Hinckes, 1, *Norfolk Square, London*. Cl. III., Sec. 6, no. 10. Cl. V., Sec. 1, no. 3.
Bolonachi, A. J. M., *London*. Cl. IV., Sec. 7, no. 12.
Borough Leather Warehouse Co., *London*. Cl. IV., Sec. 1, no. 2.
Borwell, J., *Britannia Foundry, Burton-on-Trent*. Cl. I., Sec. 8, no. 1.
Bostel, D. T., *Duke Street, Brighton*. Cl. II., Sec. 7, no. 7.
Boulnois, H. Percy, *Portsmouth*. Cl. II., Sec. 9, no. 3.
Bourtreehill Coal Co., *Dreghorn, Ayrshire*. Cl. I., Sec. 1, no. 10; Sec. 8, no. 12. Cl. II., Sec. 1, no. 15; Sec. 5, no. 13; Sec. 9, no. 10.
Bowden, William, *London*. Cl. IV., Sec. 4, no. 12; Sec. 10, no. 5.
Boyd, S., *Dublin*. Cl. IV., Sec. 10, no. 6; Sec. 11, no. 7.
Bradbury & Co., *Oldham*. Cl. I., Sec. 7, no. 16.
Bradford, T., & Co., *High Holborn, London*. Cl. I., Sec. 8, nos. 2, 7. Cl. IV., Sec. 4, no. 4.
Brady & Martin, *Newcastle-upon-Tyne*. Cl. IV., Sec. 2, no. 1. Cl. V., Sec. 1, no. 6.
Braithwaite, H. & Co., *Leeds*. Cl. II., Sec. 3, nos. 5, 6.
Branksea Island Pottery Company, Limited, *Poole, Dorset*. Cl. II., Sec. 9, no. 9.
Bray & Co., *Blackman Lane, Leeds*. Cl. III., Sec. 4, no. 5.
British and Foreign Mineral Water Company, *Glasgow*. Cl. IV., Sec. 9, no. 3.
British Sanitary Company, *Glasgow*. Cl. II., Sec. 11., nos. 2, 10.
Broad & Co., *Paddington, London*. Cl. I., Sec. 1, nos. 7, 13. Cl. II., Sec. 9, no 23; Sec. 10, no. 22.
Brock, W., & Co., 177, *Fore Street, Exeter*. Cl. IV., Sec. 2, nos. 15, 18.
Brown, A., & Co., *Glasgow*. Cl. III., Sec. 4, no. 9.
Buchan, W. P., *Glasgow*. Cl. II., Sec. 9, no. 5; Sec. 10, nos. 1, 15; Sec. 13, no. 14.
Burn & Baillie, *London*. Cl. II., Sec. 6, no. 12; Sec. 9, no. 18; Sec. 13, nos. 1, 2.
Burroughs, Wellcome & Co., *London*. Cl. IV., Sec. 3, no. 14; Sec. 7, nos. 17, 18, 19, 20, 21; Sec. 10, no. 4.
Bussey & Co., *Museum Works, Peckham, London*. Cl. IV., Sec. 2, no. 5.
Cadle, C., *Dublin*. Cl. III., Sec. 1, no. 29.
Calvert, F. C., & Co., *Bradford*. Cl. IV., Sec. 10, nos. 1, 7; Sec. 11, nos. 3, 4, 11, 12, 16, 18; Sec. 12, no. 6.
Candy & Co., *Newton Abbot*. Cl. I., Sec. 1, no. 4.
Capper, Son & Co., *London*. Cl. II., Sec. 13, no. 5.

Carron Company, *Falkirk, N.B.* Cl. III., Sec. 2, no. 12.
Carson, W., & Sons, *Dublin.* Cl. I., Sec. 1, no. 25. Cl. III., Sec 1, no. 14. Cl. IV., Sec. 6, no. 3.
Carter & Co., *Old Refinery, Bristol.* Cl. IV., Sec. 9, no. 4.
Carter, J., 6A, *Cavendish Street, London.* Cl. IV., Sec. 3, no. 2.
Casebourne & Co., *West Hartlepool.* Cl. I., Sec. 7, no. 4. Cl. V., Sec. 1, no. 7.
Chorlton & Dugdale, *Manchester.* Cl. III., Sec. 2, no. 15. Cl. IV., Sec. 2, nos. 3, 8, 9, 13; Sec. 3, nos. 4, 5, 6.
Clarke, E., & Co., *Battersea, London.* Cl. IV., Sec. 7, no. 15.
Clarke's, F. W., Portable Gas Apparatus Company (Limited), *Great Queen Street, London.* Cl. III., Sec. 4, no. 1.
Cleworth, Isaac, *Bolton.* Cl. IV., Sec. 7, no. 23.
Cliff, Joseph, & Sons, *Leeds.* Cl. I., Sec. 6, no. 9. Cl. II., Sec. 5, nos. 8, 10; Sec. 6, no. 9; Sec. 8, no. 2; Sec. 10, no. 20.
Colman & Glendenning, *Norwich.* Cl. IV., Sec. 2, no. 17; Sec. 5, nos. 3, 4.
Coltman, T., *Leicester.* Cl. I., Sec. 7, no. 11.
Compostella Fire Light Co., *Fenchurch Street, London.* Cl. IV., Sec. 4, no. 13.
Constantine Bros., *Bolton.* Cl. IV., Sec. 1, no, 17.
Constantine, T. J., *Fleet Street, London.* Cl. III., Sec. 2, no. 22.
Control Air Propeller Co., *Bolton.* Cl. III., Sec. 6, no. 20.
Cooper, H. W., & Co., *London.* Cl. III., Sec. 6, no. 8.
Cordingley, T., & Sons, *Bradford.* Cl. I., Sec. 1, no. 22; Sec. 6, no. 5.
Craig, J. & M., *Kilmarnock, N.B.* Cl. I., Sec. 1, no. 11. Cl. II., Sec. 5, nos. 5, 14; Sec. 9, no. 13; Sec. 10, nos. 2, 3, 9.
Craven, M. A., & Son, *York.* Cl. IV., Sec. 7, no. 9.
Cregeen, H. S., *Bromley.* Cl. III., Sec. 6, no. 2.
Croft Stone Quarry & Brick Co., *Croft, Leicestershire.* Cl. I., Sec. 1, no. 20.
Cuerden, R., *Bolton,* Cl. II., Sec. 3, no. 13; Sec. 6, nos. 29, 30; Sec. 7, no. 21.
Dales, J. T., *London.* Cl. IV., Sec. 4, no. 17.
Davis, H. & C., & Co., 200, *Camberwell Road, London.* Cl. III., Sec. 1, no. 1; Sec. 2, nos. 7, 9.
Davis, Joseph, & Co., *London.* Cl. V., Sec. 1, no. 4.
Dick, Alex., *London.* Cl. I., Sec. 1, no. 2.
Dillon, E. & C., *York.* Cl. IV., Sec. 1, no. 10.
Dinning & Cooke, *Newcastle-upon-Tyne.* Cl. II., Sec. 6, no. 26; Sec. 9, no. 25. Cl. III., Sec. 1, nos. 17, 19.
Dœker Hospitals and Huts Factory, *London.* Cl. I., Sec. 1, no. 28.
Dockrell, Thomas, Sons & Co., *Dublin.* Cl. I., Sec. 4, no. 3.
Donegal Industrial Fund, 43, *Wigmore Street, London.* Cl. IV., Sec. 1, no. 6.
Doulton & Co., *Lambeth, London.* Cl. I.. Sec. 1, no. 27; Sec. 5, no 1; Sec. 6, nos. 4, 7. Cl. II., Sec. 1, nos. 4, 5, 6; Sec. 3, nos.

1, 12; Sec. 4, no. 2; Sec. 5, no. 3; Sec. 6, nos. 14, 18; Sec. 7, nos. 5, 6, 12, 13, 14; Sec. 9, nos. 7, 12, 15, 16, 20, 22, 26, 30; Sec. 10, nos. 17, 19. Cl. III., Sec. 1, nos. 15, 16.

Dublin & Wicklow Manure Co., *Dublin*. Cl. IV., Sec. 11, nos. 1, 17.

Duffy & Son, *London*. Cl. I., Sec. 5, no. 7.

Duncan, Major F., *The Common, Woolwich*. Cl. IV., Sec. 3, no. 9.

Durand-Claye, A., *Paris*. Cl., V., Sec. 2, no. 2.

Edmunds, J., *London*. Cl. IV., Sec. 7, nos. 1, 2.

Edmundson, J., & Co., *Dublin*. Cl. III., Sec. 4, no. 16.

Edwards, J. C., *Trefynant, Ruabon*. Cl. II., Sec. 10, no. 4.

Elgood, Bros., *Leicester*. Cl. I., Sec. 1, no. 3.

Elliott, Edminson & Olney, *Manchester*. Cl. II., Sec. 13, no. 10. Cl. III., Sec. 2, no. 33; Sec. 4, no. 22.

Ellis, J., & Sons, *Barrow-on-Soar*. Cl. I., Sec. 1, no. 14.

Ellis, J. J., *Ellistown Collieries*. Cl. II., Sec. 10, no. 10.

Ellison, J. E., *Leeds*. Cl. III., Sec. 6, nos. 5, 14.

Elvery, J. W., & Co., *Dublin*. Cl. V., Sec. 3, no. 3.

Evans & Co., *Wrexham*. Cl. IV., Sec. 9, no. 7.

Fell, J., & Co., *Wolverhampton*. Cl. II., Sec. 1, no. 12; Sec. 6, no. 19; Sec. 10, no. 13.

Fergusson & Starkey, *Leicester*. Cl. II., Sec. 6, nos. 6, 22, 24.

Finch & Co., 181, *High Holborn, London*. Cl. II., Sec. 1, no. 11.

Fleming, W., *Dublin*. Cl. IV., Sec. 2, no. 12.

Fletcher Bros., *Dublin*. Cl. IV., Sec. 6, no. 4.

Fletcher, T., *Warrington*. Cl. I., Sec. 8, no. 8. Cl. III., Sec. 1, no. 20; Sec. 2, no. 1.

Forrest, W., *Newcastle-upon-Tyne*. Cl. III., Sec. 4, no. 2.

Foster & Pearson, *Nottingham*. Cl. II., Sec. 10, no. 18.

Foulds, E., *Leeds*. Cl. III., Sec. 2, no. 21.

Fox, William, *Leeds*. Cl. I., Sec. 7, no. 21.

Fraser Bros., *Commercial Road, London*. Cl. IV., Sec. 12, no. 4.

Fry, J. S., & Sons, *Union Street, Bristol*. Cl. IV., Sec. 7, no. 13.

Galbraith, T., *Crawford Square, Londonderry*. Cl. II., Sec. 6, no. 8.

Galloway, J., *Bolton*. Cl. I., Sec. 7, nos. 18, 19. Cl. IV., Sec. 9, no. 8. Cl. V., Sec. 5, no. 3.

Gandy, M., *Liverpool*. Cl. I., Sec. 7, nos. 2, 3.

Gardner, A., & Son, *Glasgow*. Cl. I., Sec. 5, no. 5. Cl. IV., Sec. 2, no. 6. Cl. V., Sec. 3, no. 4.

Garton & King, *Exeter*. Cl. I., Sec. 8, no. 6.

General Gas Heating and Lighting Co., 66, *St. Paul Street, London*, Cl. III., Sec. 1, no. 2; Sec. 2, nos. 2, 8.

Gent, J. T., & Co., *Leicester*. Cl. IV., Sec. 4, no. 20.

Gilbert, E. & A. E., *Broughty Ferry, Forfarshire*. Cl. II., Sec. 7, no. 18.

Gillow & Co., *Oxford Street, London*. Cl. II., Sec. 6, no. 15.

Goode & Co., *Loughborough*. Cl. II., Sec. 1, no. 7; Sec. 3, no. 9.

Graham, W., *Dublin*. Cl. IV., Sec. 1, no. 12.

Greenall, J., *Manchester*. Cl. I., Sec. 8, no. 5. Cl. III., Sec. 1, no. 8.
Gregson, J., *Bolton*. Cl. I., Sec. 1, no. 39.
Groom & Co., *London*. Cl. II., Sec. 6, no. 11. Cl. IV., Sec. 4, nos. 5, 11.
Grosvenor, F., *Glasgow*. Cl. IV., Sec. 4, no. 29.
Groves, E. K., *Bristol*. Cl. IV., Sec. 3, no. 8.
Gulliver & Co., *Aylesbury*. Cl. IV., Sec. 9, no. 2.
Hall, John, & Co., *Stourbridge*. Cl. II., Sec. 6, no. 7.
Hamilton & Co., *Leadenhall Street, London*. Cl. III., Sec. 4, no. 20.
Hamilton, W., *Brighton*. Cl. IV., Sec. 2, no. 16.
Hammond & Hussey, *High Street, Croydon*. Cl. II., Sec. 10, no. 25.
Hancock, F. & C., *Dudley, Worcester*. Cl. III., Sec. 2, no. 31. Cl. IV., Sec. 4, nos. 1, 9, 10, 27, 28.
Haresceugh, B. B., & Co., *Bentinck Street, Leeds*. Cl. II., Sec. 11, no. 11.
Hargreaves & Bardsley, *Oldham*. Cl. III., Sec. 4, no. 23.
Harriman, W., & Co., *Blaydon-upon-Tyne*. Cl. II., Sec. 7, no. 8.
Harris, G. H., *Bristol Street, Birmingham*. Cl. III.. Sec. 2, no. 24.
Harris, J. F. & G., *London*. Cl. I., Sec. 6, no. 3.
Harrison, F. J., & Co., *Leicester*. Cl. IV., Sec. 10, no. 2.
Harrison Patent Knitting Machine Co., *Manchester*. Cl. I., Sec. 7, no. 14.
Harrisson, T. Harnett, *Liverpool*. Cl. II., Sec. 12, no. 1; Sec. 13, no. 6.
Haslam, J., *Bolton*. Cl. V., Sec. 5, no. 4.
Haslam, Lewis, *Bolton*, Cl. IV., Sec. 1, no. 19.
Hassall & Singleton, *Birmingham*. Cl. III., Sec. 2, no. 27.
Hayward, Tyler & Co., *London*. Cl. II., Sec. 6, no. 28; Sec. 7, no. 9.
Headley & Sons, *Cambridge*. Cl. II., Sec. 1, no. 1.
Heap, R. R., *Manchester*. Cl. II., Sec. 11, no. 3.
Hembry & Co., *Manchester*. Cl. I., Sec. 5, no. 8.
Henderson, Osbert, *Glasgow*. Cl. III., Sec. 4, no. 3. Cl. IV., Sec. 4, no. 16.
Heron, T., *Manchester*. Cl. III.. Sec. 4, no. 4.
Hildesheim, J., *Glasgow*. Cl. V., Sec. 5, no. 2.
Hill & Hey, *Halifax*. Cl. III., Sec. 6, no. 6.
Hilliard, W. B., & Sons, *Glasgow*. Cl. IV., Sec. 3, nos. 1, 10, 12.
Hilton, W. H., *Leamington*. Cl. IV., Sec. 4, no. 3.
Hindle, Norton & Co., *Oldham*. Cl. I., Sec. 1, no. 35.
Hindley, E. S., *Bornton, Dorset*. Cl. I., Sec. 7, no. 5.
Hotblack, J., & Son, *Norwich*. Cl. IV., Sec. 1, no. 14.
Humber & Co., *Nottingham*. Cl. IV., Sec. 6, no. 1.
Humpherson & Co., *Chelsea, London*. Cl. II., Sec. 3, no. 10; Sec. 7, no. 2; Sec. 13, no. 9.
Humphreys & Thomas, *Narberth*. Cl. IV., Sec. 1, no. 20.
Hunt, Nathan, *Bristol*. Cl. III., Sec. 6, no. 3.

Cl. IV., Sec. 3, no. 7—Indicates Class IV., Section 3, no. 7.

Hutchinson, A., & Co., *Great Winchester Street, London.* Cl. IV., Sec. 4, no. 14.
Hydes & Wigfull, *Sheffield.* Cl. III., Sec. 1, nos. 12, 13.
Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham.* Cl. II., Sec. 10, no. 6.
Indian Tea Company, *Glasgow.* Cl. IV., Sec. 7, no. 14.
International Water & Sewage Purification Co., *London.* Cl. II., Sec. 2, no. 3.
Irvine & Co., *Gateshead.* Cl. IV., Sec. 7, no. 10.
Jaeger's Sanitary Woollen System Company, *London.* Cl. IV., Sec. 1, nos. 4, 7.
Jennings, G., *Stangate, London.* Cl. II., Sec. 5, no. 1; Sec. 6, no. 27.
Jennings, T., *Lambeth, London.* Cl. I., Sec. 5, no. 3.
Jewsbury & Brown, *Manchester.* Cl. IV., Sec. 9, no. 6.
Jeyes' Sanitary Compounds Company, *Cannon Street, London.* Cl. IV., Sec. 10, no. 3; Sec. 11, no. 8.
Johnson, W. F., *Leicester.* Cl. I., Sec. 6, no. 1. Cl. II., Sec. 13, no. 18. Cl. IV., Sec. 4, no. 2.
Keith, J., *London and Edinburgh.* Cl. III., Sec. 1, no. 21.
Kenworthy, E. N., & Co., *Oldham.* Cl. I., Sec. 8, nos. 4, 10, 11.
King & Co., *Hull.* Cl. IV., Sec. 4, nos. 6, 7.
Kirk, E. G., *Huddersfield.* Cl. II., Sec. 13, no. 19.
Kirkham, J. & W., *Bolton.* Col. III., Sec. 6, no. 21.
Kirsop & Co., *Newcastle-upon-Tyne.* Cl. I., Sec. 8, no. 3.
Kite, C., & Co., *London.* Cl. III., Sec. 6, nos. 11, 13, 15, 16.
Knell, U., 77, *Fore Street, London.* Cl. III., Sec. 6, no. 9.
Ladies' Sanitary Association, *Berners Street, London.* Cl. V., Sec. 2, no. 3.
Larmouth, Thos., & Co., *Salford.* Cl. IV., Sec. 5, no. 1.
Lascelles, W. H., *Bunhill Row, London.* Cl. II., Sec. 6, no. 3.
Leggott, W. & R., *Bradford.* Cl. I., Sec. 1, no. 31.
Le Grand & Sutcliffe, *Bunhill Row, London.* Cl. II., Sec. 1, no. 14.
Leicester Ambulance Corps. Cl. V., Sec. 3, no. 1.
Leoni, S., & Co., *Strand, London.* Cl. III., Sec. 2, no. 11; Sec. 4, no. 7.
Lever Bros., *Warrington.* Cl. IV., Sec. 10, no. 9.
Lewis, Mrs. A., *Manchester.* Cl. III., Sec. 2, no. 32.
London Necropolis Co., *Strand, London.* Cl. V., Sec. 6, no. 1.
Longford Wire, Iron & Steel Co., *Warrington.* Cl. IV., Sec. 2, no. 10.
Lovibond, J. W., *Salisbury.* Cl. V., Sec. 1, no. 9.
Lyon, J. W., *London.* Cl. IV., Sec. 12, no. 5.
Lythgoe, W. R., *Bolton.* Cl. IV., Sec. 7, no. 22.
McCallum, J. B., *Stafford.* Cl. I., Sec. 7, no. 8.
McGeoch, W., & Co., *Glasgow.* C. III., Sec. 2, no. 23.
Mackey, Mackey & Co., *London.* Cl. IV., Sec. 11, no. 6.
Magnetic Filter Co., *London.* Cl. IV., Sec. 8, no. 11.

Maguire & Son, *Dublin*. Cl. I., Sec. 6, no. 10. Cl. II., Sec. 5, no. 15; Sec. 7, no. 17; Sec. 9, no. 4; Sec. 13, no. 15. Cl. III., Sec. 1, no. 10. Cl. IV., Sec. 12, no. 3.
Maignen, P. A., 20 & 23, *Great Tower Street, London*. Cl. II., Sec. 2, no. 1. Cl. IV., Sec. 8, nos. 2, 5, 6, 7, 10.
Maling, C. T., *Newcastle-upon-Tyne*. Cl. II., Sec. 6, no. 16; Sec. 13, no. 16.
Manlove, Alliott, Fryer & Co., *Nottingham*. Cl. I., Sec. 7, nos. 6, 20. Cl. IV., Sec. 12, no. 2.
Maritime & General Improvement Co., *London*. Cl. III., Sec. 4, no. 21. Cl. V., Sec. 4, no. 2.
Mather & Armstrong, *Newcastle-upon-Tyne*. Cl. III., Sec. 1, no. 22; Sec. 4, nos. 6, 14.
Meyer, H. C., *New York*. Cl. V., Sec. 2, no. 4.
Midland Educational Co., *Leicester*. Cl. IV., Sec. 5, no. 2.
Mitchell, Jas., *Newcastle-upon-Tyne*. Cl. I., Sec. 8, no. 9.
Montgomerie, J., *Virginia Place, Partick, Glasgow*. Cl. IV., Sec. 7, no. 4.
Moore, J., *St. James' Walk, Clerkenwell, London*. Cl. III., Sec. 6, no. 7.
Morgan, J., *Dublin*. Cl. IV., Sec. 1, no. 11.
Morrell's Sanitary Co., *Manchester*. Cl. II., Sec. 11, no. 12. Cl. IV., Sec. 4, no. 30.
Morris, Little & Co., *Doncaster*. Cl. IV., Sec. 11, no. 9.
Morrison, W. B., *Glasgow*. Cl. I., Sec. 6, no. 12. Cl. II., Sec. 7, no. 16.
Moser, L., *Southampton*. Cl. II., Sec. 11, no. 5.
Moule's Patent Earth Closet Company, 5A, *Garrick Street, London*. Cl. II., Sec. 11. no. 7.
Murton, H. A., *Newcastle-upon-Tyne*. Cl. IV., Sec. 3, no. 11.
Musgrave & Co., *Belfast*. Cl. III., Sec. 1, no. 11.
Nailsworth Foundry Co., *Bristol*. Cl. III., Sec. 6, no. 19.
Newry Mineral Water Co., Limited, *Liverpool*. Cl. IV., Sec. 9, no. 1.
Nightingale & Co., *Great Grimsby*. Cl. I., Sec. 5, no. 4.
North of England School Furnishing Co., *Darlington*. Cl. IV. Sec. 5, no. 6.
Oates & Green, *Horley Green Fire Clay Works, Halifax*. Cl. II., Sec. 13, no. 4.
Onions, J. C., Limited, *Birmingham*. Cl. II., Sec. 11, no. 6.
Orr, J. B., & Co., *Charlton, London*. Cl. I., Sec. 3, no. 3.
Parker, J., *Woodstock, Oxford*. Cl. II., Sec. 11, nos. 1, 4.
Parkinson, Sweaney & Co., *Manchester*. Cl. II., Sec. 11, no. 13; Sec. 13, no. 23.
Parr, J., & Co., *Leicester*. Cl. IV., Sec. 6, no. 2.
Patent Porous Carbon Co., *London*. Cl. II., Sec. 2, no. 2.
Patent Victoria Stone Co., *Kingsland Road, London*. Cl. I., Sec. 1, no. 19. Cl. II., Sec. 9, no. 1.
Pearson & Co., *Dublin*. Cl. IV., Sec. 2, no. 2.

Peck, J. H., & Co., *Wigan*. Cl. V., Sec. 3, no. 6.
Pennycook Patent Glazing & Engineering Co., *Glasgow*. Cl. I., Sec. 1, no. 29.
Phillips, W., & Son, *London*. Cl. II., Sec. 9, no. 27.
Pim Bros., Limited, *Dublin*. Cl. I., Sec. 7, no. 15. Cl. IV., Sec. 2, nos. 14, 19.
Pocock, Bros., *Southwark Bridge Road, London*. Cl. IV., Sec. 2, no. 11.
Potter, G. W., *London*. Cl. II., Sec. 13, no. 11.
Potts & Co.. *Handsworth, Birmingham*. Cl. II., Sec. 10, no. 7.
Pringle, R., M.D., *Blackheath, London*. Cl. II., Sec. 13, no. 22.
Pritchett, G. E., 20, *Spring Gardens, London*. Cl. I., Sec. 5, no. 2. Cl. III., Sec. 1, nos. 23, 24; Sec. 6, no. 17. Cl. V., Sec. 1, nos. 1, 2, 5.
Purdy, W., *Nottingham*. Cl. III., Sec. 4, no. 13.
Ransome, S. E., & Co., 10, *Essex Street, London*. Cl. III., Sec. 4, no. 12.
Read, Jefferson, *Birmingham*. Cl. I., Sec. 3, no. 4.
Richardson, J., & Co., *Leicester*. Cl. IV., Sec. 11, no. 2.
Rimington Bros. & Co., *Newcastle-upon-Tyne*. Cl. II., Sec. 6, no. 4. Sec. 10, no. 5.
Roberts, C. G., *Haslemere, Surrey*. Cl. II., Sec. 1, no. 3.
Ross, J. A. G., *Newcastle-upon-Tyne*. Cl. I., Sec. 1, no. 17.
Ross, W., *Glasgow*. Cl. II., Sec. 1, no. 8.
Rothwell, W., *Bolton*. Cl. I., Sec. 7, nos. 12, 17. Cl. IV., Sec. 1, no. 21.
Ruffard & Co., Fire-Clay Works, *Stourbridge*. Cl. II., Sec. 6, no. 10.
Salmon, Barnes & Co., *Ulverston*. Cl. I., Sec. 1, no. 30.
Sanitary & Economic Supply Association, *Gloucester*. Cl. III., Sec. 1, no. 5.
Sanitary Dry Lime Co., *Bootle*. Cl. I, Sec. 1., no. 40.
Sanitary & Highway Appliance Co., *Sheffield*. Cl. II., Sec. 13, nos. 12, 17, 21.
Sanitas Company, Limited, *London*. Cl. IV., Sec. 11, no. 14.
Scott, A. & R., *Glasgow*. Cl. IV., Sec. 7, nos. 3, 5.
Scott, F. R., & Co., *Dublin*. Cl. I., Sec. 5, no. 6. Cl. IV., Sec. 2, no. 20.
Scottish Asbestos Co., *Glasgow*. Cl. I., Sec. 1, no. 18.
Selig, Sonnenthal & Co., Limited, *Lambeth Hill, Queen Victoria Street, London*. Cl. V., Sec. 3, no. 5.
Senn, C. H., *London*. Cl. IV., Sec. 7, no. 8.
Shanks & Co., *Barrhead, Glasgow*. Cl. II., Sec. 3, no. 4; Sec. 6, nos. 2, 5, 23.
Sharman, T., *Leicester*. Cl. III., Sec. 1, no. 25.
Sharp, C. H., & Co., *High Holborn, London*. Cl. III., Sec. 6, no. 12.
Sharp, Jones & Co., *Bourne Valley Pottery, Poole, Dorset*. Cl. II., Sec. 9, no. 2.
Shaw, A., & Son, *Glasgow*. Cl. III., Sec. 2, no. 29.

Shone, Isaac, *Wrexham*. Cl. II., Sec. 12, no. 2.
Short, Patrick, *Dublin*. Cl. IV., Sec. 1, no. 16.
Silicated Carbon Filter Co., *Battersea*, *London*. Cl. IV., Sec. 8, nos. 8, 9.
Silicate Paint Co., *Cannon Street, London*. Cl. I., Sec. 3, nos. 1, 2.
Sinclair, G. *Leith*. Cl. III., Sec. 3, no. 1.
Sinclair, J., *Leadenhall Street*, *London*. Cl. V., Sec. 4, no. 1; Sec. 5, no. 1.
Singer Manufacturing Company, *London*. Cl. I., Sec. 7, no. 13.
Skinner, G. H., 13, *North Street*, *Exeter*. Cl. IV., Sec. 9, no. 5.
Smallman, John L., *Dublin*. Cl. III., Sec. 4, no. 10.
Smith, E., & Co., *Coalville*, *Leicester*. Cl. I., Sec. 1, nos. 5, 23; Sec. 6, nos. 8, 11.
Smith, Elder & Co., *London*. Cl. V., Sec. 2, no. 5.
Smith, James, *Liverpool*. Cl. III., Sec. 3, no. 2.
Smith, J., & Sons, *Wolverhampton*. Cl. I., Sec. 7, no. 10.
Snell, H. Saxon, *Southampton Buildings*, *London*. Cl. III., Sec. 1, no. 18.
Société Française D'Hygiène, *Paris*. Cl. IV., Sec. 11, no. 5. Cl. V., Sec. 2, no. 1.
Spongy Iron Water Purifying Co., *Oxford Street*, *London*. Cl. IV., Sec. 8, no. 3.
Stanhope Co., Limited, *London*. Cl. IV., Sec. 4, no. 21.
Staynes & Sons, *Leicester*. Cl. IV., Sec. 1, no. 13.
Stephan, J. A., *Woscester*. Cl. IV., Sec. 8, no. 4.
Stephenson & Travis, *Liverpool*. Cl. IV., Sec. 3, no. 15.
Stewart, J., Sen., *Glasgow*. Cl. II., Sec. 9, no. 17; Sec. 10, nos. 8, 24.
Stidder & Co., 50, *Southwark Bridge Road*, *London*. Cl. II., Sec. 5, no. 9.
Stiff, James, & Sons, *Lambeth*, *London*. Cl. I., Sec. 6, no. 6. Cl. II., Sec. 10, no. 14.
Stott, James, & Co., *Oldham*. Cl. III., Sec. 4, nos. 8, 24.
Straker & Love, *Newcastle-upon-Tyne*. Cl. II., Sec. 9, no. 6.
Stretton, S., *Kidderminster*. Cl. V., Sec. 6, no. 2.
Taylor & Co., *Driffield and London*. Cl. IV., Sec. 5, no. 5.
Taylor's Cabinet Making & Upholstery Warehouse, *Bolton*. Cl. IV., Sec. 2, no. 22.
Thomasson & Key, *Worcester*. Cl. II., Sec. 5, no. 4.
Thompson, H. & Co., *London*. Cl. I., Sec. 3, no 5.
Thorn & Co., *Stafford*. Cl. IV., Sec. 8, no. 1.
Thornburn, Will., *Borough Bridge*. Cl. III., Sec. 1, no. 26.
Torrance, W. H., *Edinburgh*. Cl. IV., Sec. 7, no. 7.
Townsend & Co., *Newcastle-upon-Tyne*. Cl. IV., Sec. 3, no. 13.
Trott, H., *Battersea*, *London*. Cl. II., Sec. 1, no. 9; Sec. 7, no. 11.
Turk, R. J., *Kingston-on-Thames*. Cl. IV., Sec. 6, no. 5.
Twyford, T., *Hanley*. Cl. II., Sec. 5, no. 17; Sec. 6, no. 17; Sec. 13, no. 7.

Cl. IV., Sec. 3, no. 7—Indicates Class IV., Section 3, no. 7.

Tylor, J., & Sons, 2, *Newgate Street, London.* Cl. II., Sec. 1, no. 10; Sec. 3, nos. 2, 7: Sec. 5, nos. 7, 16; Sec. 6, nos. 20, 21; Sec. 7, nos. 3, 19; Sec. 8, no. 1; Sec. 13, no. 8.
Tyrrell, Brooke, *Dublin.* Cl. IV., Sec. 1, no. 3.
Vause, J., & Son., *Bolton.* Cl. II., Sec. 3, no. 14; Sec. 5, no. 18; Sec. 6, nos. 31, 32; Sec. 7, nos. 22, 23; Sec. 8, no. 3; Sec. 9, no. 31.
Verity, E. & J. M., *Leeds.* Cl. III., Sec. 2, no. 20.
Vernon's Patent China & Glass Co., *London.* Cl. IV., Sec. 4, no. 15.
Vicars, T. & T., *Liverpool and London.* Cl. III., Sec. 3, no. 4.
Vipan & Headly, *London.* Cl. IV., Sec. 4, nos. 23, 25, 26.
Walker, Chas. W., *Wandsworth Common, London.* Cl. IV., Sec. 12, no. 1.
Walker, Turnbull & Co., *Falkirk.* Cl. III., Sec. 2, nos. 17, 28.
Waller, Thos., 47, *Fish Street Hill, London.* Cl. III., Sec. 2, no. 16.
Walton, F., & Co., *London.* Cl. I., Sec. 4, no. 2.
Ward, E., & Co., *Bradford.* Cl. IV., Sec. 1, nos. 1, 5, 9.
Ward, O. D., *London.* Cl. II., Sec. 7, no. 10.
Warner, J., & Sons, *London.* Cl. II., Sec. 1, no. 13.
Waterproof Paper and Canvas Co., *London.* Cl. I., Sec. 1, no. 24.
Watson, Henry, & Son, *Newcastle-upon-Tyne.* Cl. II., Sec. 3, no. 8; Sec. 7, nos. 4, 15.
Webb, A., *Dublin.* Cl. IV., Sec. 1, no. 15.
Webb, H. Chalk, *Worcester.* Cl. I., Sec. 6, no. 2.
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READ BEFORE THE BOLTON CONGRESS, 1887.

ADDRESSES AND LECTURES.

Right Honourable Lord Basing, F.R.S. President's Address.

Professor J. Russell Reynolds, M.D., F.R.S., F.R.C.P. Address to Section I.

Professor T. Hayter Lewis, F.S.A., F.R.I.B.A. Address to Section II.

August Dupré, PH.D., F.I.C., F.C.S., F.R.S. Address to Section III.

Arthur Ransome, M.D., F.R.S. Lecture to the Congress.

A. Wynter Blyth, M.R.C.S. Address to the Working Classes.

Major Lamorock Flower. Address to the Working Classes.

Henry Law, M.INST.CE. Address to the Working Classes.

PAPERS.

Bradshaw, J. J., F.R.I.B.A. Sanitary Condition of Cotton Factories.

Carpenter, Alfred, M.D. Our Pioneers.

Chadwick, Edwin, C.B. Sanitary Condition of Water Supplies.

Chadwick, Edwin, C.B. Sanitary Sewage and Water Supply.

Chudleigh, Reverend R. A. On the Present Position of M. Pasteur in relation to Public Health.

Collins, J., F.C.S., F.G.S. River Pollution in Lancashire and how to meet it.

Corbett, J. Health, Comfort and Economy in Cottage Construction.

de Rance, C. E., ASSOC.INST.C.E., F.G.S., F.R.G.S. Underground Water Supplies.

Duncan, D. J. Russell. Smoke Abatement.

Fletcher, H. Smoke Abatement.

Flower, Major Lamorock. The Fouling of Streams.

Frankland, Percy, PH.D., F.C.S. The Application of Bacteriology to questions relating to Water Supply.

Haldane, J. S., M.A., M.B. The Air of Buildings and Sewers.

Honeyman, J., F.R.I.B.A. The size of House Drains, and the use and misuse of Traps.

Hope, E. W., M.D., L.R.C.P., ASST., M.O.H., Liverpool. Recent localised outbreak of Typhus in Liverpool.

Kenyon, G. A., M.B., L.R.C.P., M.O.H., Chester. Provision for Infectious Patients in Rural Districts.

Livy, John, M.D. Remarks on the History and Progress of Public Health.

McKeown, D., M.A., M.D. Prevention of Blindness.

Middleton, R. E., M.INST.C.E., M.I.M.E. House Drainage.

Middleton, R. E., M.INST.C.E., M.I.M.E. Sanitary Registration of Buildings Bill.

Orvis, Orland D. Smoke Abatement.

Parkes, Louis, M.D. Water Analysis.

Sergeant, E., L.R.C.P. LOND., M.R.C.S., M.O.H., Bolton. Notes on the Sanitary Improvements of Bolton during the ten years ending 1886.

Sutcliffe, R. Artesian Wells and Water Supply.

Sykes, J. F. J., B.SC., D.P.H., M.B., Supervision of Dairies, Cowsheds, and Milk Shops.

Taylor, J. Stopford, M.D., L.R.C.P., F.L.S., M.O.H., Liverpool. Liverpool Port Sanitary Authority and its Work.

Terry, S. H. Village Water Supply.

Vacher, Francis, F.R.C.S., M.O.H., Birkenhead. Death Causes and their Classification.

ADDRESSES AT THE ANNUAL AND ANNIVERSARY MEETINGS.

Galton, Captain Douglas, R.E., C.B., D.C.L., F.R.S. Annual Address, 1887.

Poore, G. V., M.D. Anniversary Address, 1887 : The Shortcomings of some Modern Sanitary Methods.

Corfield, Professor W. H., M.A., M.D. Annual Address, 1888.

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LIST OF DONATIONS.

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Addiscott, W. J., Health, and how to promote it.	The Author.
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LIST OF FELLOWS, MEMBERS, AND ASSOCIATES, ELECTED JANUARY, 1887, TO NOVEMBER, 1888.

FELLOWS.

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